User-Driven Change enabled by Malleable Information Technology

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LIST OF ABBREVIATIONS

AAP	Autonomous affordance perception
AA	Affordance Actualization
AVE	Average Variance Extracted
AP	Affordance Perception
BPAP	Being Pushed Affordance Perception
CI	Confidence Interval
df	Degrees of freedom
DI	Deliberate Initiatives
DV	Dependent Variable
EFA	Exploratory Factor Analysis
EoS	Ease of Support
ERP	Enterprise Resource Planning
EXAP	Exploring Affordance Perception
GFI	Goodness of Fit Index
HAP	Heteronomous affordance perception
HR	Human resource
HTMT	Heterotrait-monotrait ratio
Interv.	Interval
IMAP	Imitating Affordance Perception
IS	Information System
IT	Information Technology
NFI	Normed Fit Index
PIIT	Personal Innovativeness with IT
PLS	Partial Least Square
OPU	Other People Use
R&D	Research and development
RMSEA	Root Mean Square Error of Approximation
SCT	Social cognitive theory
SE	Self-Efficacy
SEM	Structural Equation Modeling
SoP	Sense of Power
SP	Microsoft SharePoint

SRMR	Standardized Root Mean Square Residual
Std	Standard
TKT	Technical Knowledge Team
TRAP	Transferring Affordance Perception
VIF	Variance Inflation Factor

CHAPTER I INTRODUCTION

1 User-driven Change under Malleable Information Technology

Today, organizations continue to spend trillions of dollars on information technology (IT), with enterprise software investment's growth significantly outperforming other IT areas (Gartner 2018). A decent share of these investments for enterprise software is spent on malleable IT, such as collaboration platforms (Maruping and Magni 2015). Malleable technologies have in common that users can modify them on their own and that they have a broad usage focus (Kallinikos et al. 2013; Richter and Riemer 2013; Schmitz et al. 2016). Investments in such technologies pay off if users adapt them to their needs and apply them in effective use for their work (Burton-Jones and Volkoff 2017; Majchrzak et al. 2000). These adaptations of technology and incorporations into work tasks occur in the post-adoption phase of a technology's implementation and often through voluntary individual use extensions (Bagayogo et al. 2014; Jasperson et al. 2005).

Yet, the transition from generic potentials of malleable IT to effective use poses some challenges. For organizations, it is difficult to plan the adoption of malleable IT, since usefulness (i.e., an important indicator from existing research to predict technology acceptance) and, hence, adoption (Davis 1989; Venkatesh et al. 2003), must be anticipated individually and are difficult to determine a priori for malleable IT (Richter and Riemer 2013). Additionally, the number of used features is not an appropriate measure for adoption under malleable IT, since the purpose for which the features are used is more important than whether they are used at all (Richter and Riemer 2013). For example, the same feature could be applied by a single user for different tasks and could generate a value in all used scenarios.

An additional layer of complexity exists in scenarios, in which users actively adapt the malleable IT (Schmitz et al. 2016). In these scenarios, users create or modify artifacts based on malleable IT that not only affects their individual work tasks but potentially influence how other users enact their work. These adaptations induce emergent change for related routines, which may lead to complex dynamics of consecutive changes over time (Goh et al. 2011; Leonardi 2011). All of these challenges depend highly on individual users and their behavior. Unlike purpose specific enterprise software, where users can be guided through prescribed usage scenarios (Richter and Riemer 2013), the post-adoption phase of malleable IT demands much more often that individual users leave their comfort zones and become actively involved to leverage potentials. This puts a heavy burden on individual users and may lead to strong variations for the success of malleable IT implementation projects.

We know little about how and when users invest efforts to leverage potentials of malleable IT and how these investments may lead to consecutive changes. The users face at least two challenges in the process to actualize potentials. First, users need to perceive potentials offered by malleable IT to support their work tasks. Second, if users have identified potential use scenarios, they may need to adapt the malleable IT to fit those use scenarios. Users can fail in both steps either by not perceiving potentials at all or by getting stuck in the adaptation of malleable IT. In addition, if they succeed and actualize a potential, the impact of this actualization depends on the conditions, in which the changed work task is embedded. The goal of this dissertation is to analyze the process of how and when users perceive and actualize potentials under malleable IT and how these actualizations may lead to changes in related routines over time.

2 Overview of the Dissertation

The dissertation comprises three studies related to user-driven change under malleable IT during the post-adoption phase. The first two studies focus on user perception and actualization of malleable IT potentials by applying different methodologies and utilizing affordance theory. The third study focuses on user-driven routine change based on actualized potentials of malleable IT. The following paragraphs summarize each study, present the motivation, and address targeted gaps.

The first study explored *how and when users actualize affordances with collaboration platforms*. In the context of this study, collaboration platforms are used as an example of malleable IT. Collaboration platforms provide generic features that users can adapt and incorporate in their work (Majchrzak et al. 2000; Maruping and Magni 2015; Zhang et al. 2011). These generic features provide almost endless potentials, if users perceive and actualize possibilities to apply them to perform their particular tasks in a more efficient manner. Unfortunately, we know little about the individual perception and actualization processes under collaboration platforms. In particular, we have limited knowledge of the possible perception processes in this scenario as well as how the generic nature of collaboration platform features influence the actualization through required local configuration (Briggs et al. 2013) and the flexible application of the same feature to support different work tasks. This study used the concept of affordances (i.e., potentials for goal-oriented action that a particular technology offers to particular users) (Volkoff and Strong 2013), and their actualization to analyze the process of how users incorporate generic features of collaboration platforms into their work. It also explained under which conditions users engage in affordance actualization or get stuck in the actualization process. The study achieved this by capturing user actualizations over a period of two years in a case study research.

In the second study, the goal was to test *how determinants based on social cognitive theory influence affordance perception of individual users under malleable IT*. Existing research focuses on identifying specific affordances of IT and analyzes the effect of their actualization (e.g., Leidner et al. 2018; Strong et al. 2014). For malleable IT, this approach is not feasible since it provides an almost endless number of affordances depending on single user's perceptions (Richter and Riemer 2013). Thus, the analysis for malleable IT should start before the actualization with the perception of affordances. Unfortunately, affordance perception is almost absent from current research (Pozzi et al. 2014), and its relation to affordance actualization also remains unclear (Bernhard et al. 2013). Study 1 showed that affordance perception manifests in different processes. Based on this insight, Study 2 wants to test what determinants influence these processes and how the resulting affordance perceptions relate to affordance actualizations. The study presents arguments that individual affordance perceptions under malleable IT are primarily influenced by personal and environmental factors. Therefore, social cognitive theory (SCT) (Bandura 1986) is integrated with affordance theory by deriving influence factors for affordance perceptions from SCT. These influence factors are expected to trigger different affordance perception mechanisms. The study tests the resulting hypothesis using a survey research approach.

The third study explored *why the momentum of routine change associated with malleable IT varies between routines*. Study 1 and Study 2 focused on single changes through affordance actualizations of users enabled by malleable IT, whereas the third study frames these changes as changes in routines (i.e., patterns of interdependent work that involve multiple actors) (Feldman and Pentland 2003). Prior research showed that routines change and evolve enabled by IT (e.g., Berente et al. 2016; Goh et al. 2011; Leonardi 2011; Polites and Karahanna 2013). Routines change because of endogenous reasons (e.g., the availability of a new technology) (Edmondson et al.

2001), and exogenous reasons (e.g., learning from past performances) (Feldman 2000; Feldman and Pentland 2003). While a great deal of research focused on the nature of change, few studies have analyzed the intensity of change. Users can conduct a series of consecutive changes before reaching a new stable version of the routine. Building on the theory of momentum of change (Jansen 2004), this study wants to explain the variation in this momentum of routine change. Furthermore, it also analyzes the influence of coordinative embeddedness (Howard-Grenville 2005) and pre-existing artifacts on momentum under the condition of malleable IT. This study compares the momentum of identified routines over more than three years and derives a theory to explain the intensity of change.

3 Research Design

The purpose of this dissertation is to contribute to a theory of user-driven change under malleable IT. The research strategy consisted of two consecutive phases that applied different methodologies: qualitative and quantitative. The consecutive application of these two methodologies allowed for both the exploration and the explanation of differences of user-driven change under malleable IT. Both methodologies were applied in the same organizational context at Alpha. Alpha was a medium-sized mechanical engineering organization that had implemented Microsoft SharePoint (SP) to foster collaboration among its subsidiaries. SP supports many different usage scenarios by allowing the creation of sites (i.e., distinct areas within SP). Users can adapt these sites by configuring and combining generic features of SP. Alpha allowed such adaptations and provided the users with a high degree of discretion. These properties make SP a malleable IT and provide an appropriate set-up for our research.

In the first phase of the dissertation, the focus was on the exploration of user-driven change processes enabled by malleable IT. Therefore, the strategy was to accompany multiple users from different teams after the implementation of such a technology over a long period of time to observe emergent changes. Case study research is an appropriate method for such an endeavor (Yin 2003). The data collection for the case study took place between November 2014, shortly before the go-live of SP, and December 2017. The primary data source was a total of 59 interviews with 14 users from five different teams. The interviews were conducted in nine different rounds scheduled every four to five month-intervals during more than three years of observation. Archival data, including project documentations and direct system access complemented the data collection and were used for triangulation. This data allowed us to observe how users perceived and actualized potentials to incorporate SP in their processes and how they drove change in these processes over time. The data collected in this phase of the dissertation was analyzed by applying two different lenses: affordance theory (Study 1) and routine theory (Study 3).

The second phase of the dissertation built on the initial results of Study 1 in order to deepen the understanding of how users perceive potentials of malleable IT. The focus in this phase was to test parts of the former case study-based results with a quantitative method. A survey research approach was chosen that allowed the collection of multiple users' answers. The survey was conducted among all users of SP at Alpha and took place between January and February 2018. 154 responses were collected and analyzed using PLS-SEM. The underlying model relied on affordance theory as well as SCT (Study 2).

The rest of the dissertation is structured as follows. Chapter II presents Studies 1 and 2, which both deal with affordance perception and actualization under malleable IT by applying different methodologies. Afterward, Chapter III describes Study 3, which focuses on the momentum of routine change under malleable IT. Chapter IV closes the dissertation by concluding on the implications for research and practice. Table I-1 summarizes the most important components of the three studies.

	Study 1: How Users Perceive and Actualize Affordances: An Exploratory Case Study of Collaboration Platforms	*Study 2: Explaining Differences in Affordance Perception under Malleable Information Technology: A Social Cognitive Theory Perspective*	*Study 3: Change of Organizational Routines under Malleable Information Technology: Explaining Variations in Momentum*
Theoretical Foundation	Affordance Theory, Feature Use	Affordance Theory, Social Cognitive Theory	Routine Theory, Momentum of Change
Research Question	*How and when do users actualize affordances with collaboration platforms?*	*How do determinants based on social cognitive theory influence affordance perception of individual users under malleable IT?*	*Why does the momentum of routine change associated with malleable IT vary between routines?*
Method	Exploratory Longitudinal Case Study	Confirmatory Survey Research	Longitudinal Case Study
Data Sources	Primary: 47 semi-structured interviews with 12 different users in seven rounds. Complementary: Archival documents, system access	154 responses from survey in an organizational context	Primary: Interviews from Study 1 plus 12 additional semi-structured interviews with in total 14 users in nine rounds. Complementary: Archival documents, system access
Data Analysis	Coding, pattern matching	Quantitative Data Analysis with PLS-SEM	Coding, pattern matching
Time Period Data Gathering	November 2014 to January 2017	January to February 2018	November 2014 to December 2017
Publication Status	A previous version was published in the Proceedings of ICIS 2017 (Lehrig et al. 2017)	Working Paper	A previous version was accepted at ICIS 2018 (Lehrig and Krancher 2018)
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Own Contribution	Major	Major	Major

Table I-1 Overview of Studies

CHAPTER II AFFORDANCE PERCEPTION AND ACTUALIZATION UNDER MALLEABLE INFORMATION TECHNOLOGY

STUDY 1 HOW USERS PERCEIVE AND ACTUALIZE AFFORDANCES: AN EXPLORATORY CASE STUDY OF COLLABORATION PLATFORMS

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Abstract

The success of collaboration platforms depends on the degree to which users incorporate generic platform features into their particular collaborative actions, yet little is known about the processes through which users perceive and actualize the potentials for action, or affordances, offered by collaboration platforms. We report the results of an exploratory case study in which we observed collaboration platform users over a period of over two years. We find that users perceive affordances through three alternative processes: imitating, exploring, and transferring. After perceiving affordances, users often need to arrange for configuration to enable the perceived action potential. Configuration can be found in three forms: delegated, guided, or autonomous configuration. Our emerging theory suggests that these perception and actualization processes depend in complex ways on individual level (knowledge, self-efficacy, perceived complexity) and higher-level (advice networks, collective knowledge) factors. Our study helps open the black box of affordance perception and actualization processes.

Keywords: Affordances, Affordance Actualization, Affordance Perception, Collaboration Platforms, User Behavior

1 Introduction

Many organizations rely on collaboration platforms, such as Microsoft SharePoint (SP), to increase the efficiency of collaborative work (Kang et al. 2012; Kolfschoten et al. 2012; Maruping and Magni 2015). A key characteristic of collaboration platforms is that they provide users with relatively generic features, such as lists, notifications, or search (Zhang et al. 2011). Users are then required to find ways to incorporate these generic features into their particular collaborative work in order to achieve goals that are meaningful to them. For instance, production planners may start using the list feature and the alert feature of a collaboration platform to keep sales personnel and shop floor operators informed about order status changes. In doing so, they find a way to use generic features (list and alert) for purposes that are meaningful to production planners (keeping others informed about order status changes). This example shows that the benefits from collaboration platforms critically hinge on the degree to which users perceive and actualize the many possibilities in which they can use generic platform features to perform their particular collaborative work in a more efficient manner. Unfortunately, research on feature use suggests that this potential is often highly underutilized because users tend to use a very limited number of features (Jasperson et al. 2005) and infrequently revise their usage patterns over time (Wang et al. 2008). Even if organizations train users in preconceived use scenarios that are applicable to many users (Kang and Santhanam 2003), users may still struggle to recognize many of the ways in which they can leverage the platform features in their particular, local collaborative work. Thus, much of the potential offered by collaboration platforms remains untapped. An important question for organizations striving to realize the full potential of collaboration platforms is therefore how and when users perceive and actualize the potentials for action offered by collaboration platforms.

The literature on affordances and feature use provide some perspectives on this question. The affordance literature aims to explain how users realize affordances, i.e., potentials for goal-oriented action that a particular technology offers to particular users (Volkoff and Strong 2013). Affordance theorists often posit that users realize affordances through a two-phase process: affordance perception and affordance actualization (Bernhard et al. 2013). Affordance perception describes the moment when a user becomes “aware of the existence of an action possibility” (Bernhard et al. 2013, p. 5). Whether a user perceives an affordance depends on the information available to the user (Bernhard et al. 2013). The feature use literature adds that a specific type of user behavior, exploring, may result in users becoming aware of a new way of using a technology (e.g., Hsieh et al. 2011; Liang et al. 2015; Maruping and Magni 2015). The second phase, affordance actualization, denotes the actions taken by individuals to realize the action potential (Strong et al. 2014). The affordance literature suggests that whether affordances are actualized depends on actualization efforts, or the degree of difficulties associated with actualizing the affordances (Bernhard et al. 2013).

Although these relatively new pieces of literatures have contributed important knowledge, we note three critical gaps. First, we have limited knowledge of the processes that lead to affordance perceptions. While it appears plausible that affordances are recognized through information that is available to a user, it is unclear which processes users obtain such information through. Although the feature use literature adds that exploring is one such process (e.g., Hsieh et al. 2011; Liang et al. 2015; Maruping and Magni 2015), it remains unclear whether other important processes may, also result in affordance perceptions. Second, the literature scarcely appreciates the peculiarities of relatively generic but malleable technology such as collaboration platforms (Kallinikos et al. 2013). Designers cannot predefine all possible use cases for collaboration platforms (Orlikowski 1996). Thus, platforms require local configuration to support particular tasks (Briggs et al. 2013) or to contextualize information (Zhang et al. 2011). Although some literature emphasizes this malleable, configurable nature of many contemporary technologies, configuration actions are largely absent from current conceptions of actualization processes (Bernhard et al. 2013; Strong et al. 2014). Third, in particular the feature use literature focuses on features rather than on the actions that the features enable. Yet, in collaboration platforms, which provide relatively generic features, a single feature may be used to support a variety of actions. In other words, a single feature may offer many affordances. A longitudinal perspective may be particularly helpful for exploring how users come to actualize several affordances from the same feature. However, with few exceptions (Strong et al. 2014), such longitudinal perspectives are still rare. By targeting these gaps, we hope to gain a better understanding of the affordance actualization process in the context of collaboration platforms. With a better understanding of this process, we will also better understand the obstacles in the process, or why affordance actualization processes can get stuck. These understandings are likely to help organizations more fully leverage the potential of collaboration platforms.

Our study addresses the following question: *How and when do users actualize affordances with collaboration platforms?* In an exploratory case study, we examined the affordance actualization process in an organization that implemented SP as a collaboration platform. We conducted 47 interviews with 12 users over a duration of more than two years, collecting data at seven points in time. We then unveiled three processes of how affordances are perceived (imitating, exploring and transferring). Additionally, we uncovered that affordance actualizations may involve three types of configuration processes (delegated, guided and autonomous). Although most users were engaged in a variety of perception and configuration processes, we also found important differences between users and within users over time. Our emerging theory suggests that these differences can be explained by initial differences and changes in the users' technical knowledge, by perceptions of task complexity, and by users' self-efficacy. Furthermore, we identified external factors (advice networks and collective knowledge) that influenced the affordance actualization processes. Our key contribution is an emerging theory of affordance perception and actualization processes.

The remainder of this paper is organized as follows. We briefly review the literature on concepts related to affordance actualization. Afterward, we describe our methods, present our findings and the emerging theory, and discuss implications and contributions.

2 Related Literature

We build on affordance theory to examine how users realize action potentials from collaboration platforms. Affordances describe the action potentials offered to someone or something by an object (Volkoff and Strong 2013). Gibson introduced the term affordance (Gibson 1979), which is rooted in psychology. He coined the term based on his observations of animals and their interactions with objects in their environment. For instance, a path allows pedestrian animals to move from one place to another, whereas obstacles prevent such movement (Gibson 1979). Later Norman applied the affordance concept to human machine interaction (Norman 1999). However, Norman's definition deviated from Gibson's definition in important ways. Most importantly, Norman assumed that affordances are designed into technology and that designers should make them perceivable (e.g., Hutchby 2001; Leonardi 2011). We do not follow Norman's interpretation of affordances in this study. We assume that collaboration platforms contain generic features (e.g., lists, alerts) and that the potential for local action (e.g., keeping sales personnel informed about order status changes) offered by these features is typically not anticipated by designers of the collaboration platform but instead is discovered by particular users in particular contexts. This is in line with a relational affordance lens (Hutchby 2001) as it has recently been endorsed in many information systems (IS) studies (e.g., Gaskin et al. 2014; Goh et al. 2011; Leonardi 2011; Zammuto et al. 2007). Consistent with this perspective, we define an affordance as a ”relationship between a technical object and a specified user that identifies what the user might be able to do with the object, given the user's capabilities and goals” (Markus and Silver 2008, p. 622).

Several points of this definition are noteworthy. Affordances refer to what users can do with given technical objects. These potential actions are related to the user's specific goals. Technical objects, or features in our study, are thus not the same as affordances. One feature (e.g., the list feature in SP) may enable the user to engage in a variety of actions that are meaningful given the user's goals. For instance, the list feature may enable a quality manager to track relevant technical norms but also to monitor orders. The definition also emphasizes that the pure existence of an affordance is not sufficient for an action to occur. Users need to actualize the affordance (Strong et al. 2014).

The affordance actualization process has lately gained interest in IS research (Bernhard et al. 2013; Pozzi et al. 2014; Strong et al. 2014) but remains poorly understood. The full process consists of four distinct phases: affordance existence, affordance perception, affordance actualization and effect (Bernhard et al. 2013). We will focus on the second and third phases (perception and actualization) in this paper as these phases are characterized by active user involvement, whereas the existence phase defines the hypothetical option space given the technology and the user characteristics and the effect phase captures the results of the actualization on an organizational level (Strong et al. 2014). *Affordance perception* describes the event of a user becoming aware of an action possibility (Bernhard et al. 2013). After an affordance perception, a user has at least a vague understanding of the potential for a particular action offered by a collaboration platform. Affordance perception is enabled through information about the affordance (Bernhard et al. 2013). This information may be inherent to the artifact itself through the symbolic expressions of features (Markus and Silver 2008). For instance, in SP, a “+” symbol on top of libraries denotes the possibility to upload a document. Another source for information about an affordance is external sources (Bernhard et al. 2013). For example, a user may observe how another user activates alerts to receive personalized notifications on changes to a document. The observation of this use may then lead the user to recognize that she, too, could use the alert feature for a particular purpose. In contrast to these positive examples, users can also misperceive affordances by picking up misinformation (Gibson 1979). For example, a user perceives that he can use SQL statements within SP, because he has heard something about SQL in the context of SP. However, users cannot use SQL statements in SP. The user may not realize his misperception until an unsuccessful affordance actualization attempt (i.e., he tries SQL statements in SP and fails) (Shaw et al. 1982).

Affordance actualization is defined as "the actions taken by actors as they take advantage of one or more affordances through their use of the technology to achieve immediate concrete outcomes in support of organizational goals" (Strong et al. 2014, p. 70). Thus, actualization is the actual use of the technology for an action (Bernhard et al. 2013). In this paper, we refer to affordance actualization as the initial use of an artifact for a specific goal. Hence, we do *not* consider the repeated use of an artifact for the same purpose as another instance of an affordance actualization. The factors influencing the perception and actualization of affordances are currently only adumbrated in literature. For example, Strong et al. identify the key factors as "individual abilities and preferences", "EHR's features" and "work environment characteristics", all of which lead individuals to take different actualization actions (Strong et al. 2014, p. 72). These generic factors draw a rough image of the factors but require more research to improve our understanding of affordance actualizations. We also still know little about the impact of change in these factors over time. For example, knowledge is seen as a factor that increases over time and allows the perception of new affordances through the user (Strong et al. 2014). However, it remains unclear how affordance perception processes at such an increased knowledge level differ from previous affordance perception processes at lower knowledge levels.

Furthermore, how users move from perception to actualization remains a black box. To the best of our knowledge, the configuration processes required to actualize a perceived affordance are rarely discussed in affordance literature. However, configuration is an important activity in collaboration platforms (Kolfschoten et al. 2012) and thus is eminent for affordance actualizations. Therefore, we would profit from a better understanding of configuration within the affordance actualization process. Next, we present how we addressed these gaps through an exploratory case study.

3 Method

We conducted a longitudinal case study to explore the processes through which users perceive and actualize the affordances offered by collaboration platforms. The case study method is appropriate for this objective for three reasons. First, it allows for uncovering the process, or mechanisms (Flyvbjerg 2006) through which affordance perceptions and actualizations occur in a real organization. Second, the case study method is likely to reveal differences in these processes between cases, which is important for developing explanations for the occurrence of these processes (Eisenhardt 1989; Yin 2003). Third, the case study method allowed us to follow individuals over time, which provided some insights into how initial instances of affordance perceptions and actualization processes influence later instances of these processes (Yin 2003).

3.1 Case Set-up

We conducted the case study at Alpha, a medium-sized mechanical engineering company with locations in Switzerland and Germany. Our study began in November 2014, when Alpha was about to implement SP to foster collaboration within and between its subsidiaries. Two characteristics of the post-implementation phase of SP at Alpha were particularly noteworthy. First, Alpha left very high levels of discretion to its employees in terms of configuration and use of their own SP based collaboration environments so-called “sites”. That is, employees were free to choose which components of the sites (e.g., libraries, lists, permission settings) they wanted to use and for what purpose. Second, because of scarce resources, Alpha’s IT department was hardly able to support users in the configuration of SP. Thus, users had to rely on the help of knowledgeable peers or consultants. High user discretion and low support by the IT department were contextual conditions that made it particularly likely to observe how users themselves perceive and actualize affordances. Thus, the post-implementation phase of SP provided a *revelatory case study* context (Yin 2003), in which processes of affordance perception and actualization were particularly likely to occur.

We chose an embedded-case design (Yin 2003) with two levels of analysis: (1) users and (2) the affordance actualizations in which a particular user engaged over time. At the first level, we selected five users from different functional units (e.g., quality management and research & development) from different management levels (e.g., managers and assistants) and different locations in Switzerland and Germany. We selected the interview partners based on maximal variation and initial interest in SP. These users typically engaged in several instances of affordance perceptions and actualizations over time, which were our embedded units of analysis. We chose this case design to capture the relationship between users and affordance perceptions and actualizations. This relationship is important because affordance theory presumes the influence of users on the affordance actualization process.

3.2 Data Collection

We collected data over a period of more than two years, from November 2014 to January 2017. Our primary data source was 47 semi-structured interviews, supplemented by archival data extracted from SP. We conducted the interviews in seven rounds[1]. Interviewing the same users over time allowed us to identify changes in affordance actualization processes. The interviewees comprised the individuals that we had selected as research cases and other individuals (e.g., individuals mentioned in the interviews, members of the IT department) that were able to provide further contextual information. We conducted the first interviews when the system became available for use in November 2014. In the first round, we asked the users how they came to use SP in their work and about their plans for use. We also asked questions regarding their personal experience (e.g., their information technology experience and their tenure). We scheduled the subsequent interviews at intervals of three to four months and continued the interviews until January 2017. In these interviews, we asked users to report about important events related to SP, such as trainings, configurations or the creation of new sites. We also encouraged them to describe their current use and problems. We then asked follow-up questions to elicit information about the affordance perception and actualization processes that had led to the use. The interviews took between 30 and 90 minutes.

Two further types of data sources served to triangulate the information obtained from the interviews with the five users that were our research cases. First, we extracted archival data from SP. For example, after one interviewee told us that she was using SP to version documents in her team, she provided us with the link to the team site and we were able to examine the configuration settings she had made in her team site. Thus, we were able to verify that the mentioned actualization had taken place. Second,

[1] Two users participated in all seven rounds, two users left the organization after the fifth round, and one user missed an intermediary interview.

we used data from interviews with related team members and compared this information to the information obtained from the interviews with our five research cases. For example, one interviewee described the process of how his team reports on project status with SP. Afterward, we asked one of his team colleagues to describe his view on the same process. This allowed the validation of the two descriptions for consistency.

3.3 Data Analysis

We followed an inductive data analysis approach with the goal of generating theory (Eisenhardt 1989). The process consisted of four steps. First, we created a write-up of the interviews. Second, we identified instances of affordance perceptions and actualizations. We coded an affordance perception when a user became aware of the possibility of using SP for a specific purpose for which the user had not used SP before, and we also coded an affordance actualization when a user began using SP for a purpose for which the user had not used SP before. For instance, one user reported that she had activated the checkout feature of SP to enable a distributed team to manage a common database of machine orders. Table II-2 and Table II-4 provide further coding examples. Third, we developed categories of affordance perception processes and affordance actualization processes by comparing instances of these processes (Glaser and Strauss 1967). These categories address the question of *how* users perceive and actualize affordances. In developing these categories, we discovered that affordance actualization processes often consisted of two steps: configuration and initial use. Building on this subdivision, we identified distinct categories of configuration processes in our data. In our ongoing analysis, we used the category definitions in later interviews for validation and refinement. Fourth, we built explanations for *when* (i.e., under what conditions) users engaged in these particular categories of affordance perception and affordance actualization processes. We built potential categories by analyzing changes in the affordance actualizations of a particular user over time and by comparing affordance actualization processes between users. This was an iterative process of constant comparison (Glaser and Strauss 1967), in which we developed potential categories and dismissed or retained them while validating them in other instances of affordance actualizations. To increase the confidence in our analysis, we relied on investigator triangulation (Yin 2003) by regularly discussing preliminary results in our research team and by giving our raw data to independent students for analysis. We discussed variations in the analysis results and incorporated them in our model if suitable. While our analysis on the third and fourth steps unfolded, we also compared our findings with the literature on affordance actualizations and feature use, a practice called theoretical integration in inductive research (Eisenhardt 1989).

4 Findings

Our data revealed important differences - between users and over time - in the processes through which users perceived and actualized affordances. We first present categories of these affordance perception and actualization processes. We then provide detailed accounts of two users to illustrate the conditions for and sequences of these processes. Finally, we propose an emergent theory to explain the occurrence of these distinct processes.

4.1 Categories of Processes

4.1.1 Affordance Perception Processes

We found three categories of affordance perception processes in our data: imitating, exploring and transferring. Table II-1 and Table II-2 provide the definitions and example quotes of these categories.

Process	Description
Imitating	A user perceives the possibility to use the technology for a new purpose by learning about another person's use.
Exploring	A user perceives the possibility to use the technology for a new purpose by interpreting the symbolic expressions of the technology.
Transferring	A user perceives the possibility to apply the user's existing way of using the technology to a new purpose.

Table II-1 Definitions of Affordance Perception Processes

Imitating. Users often first perceived new ways of using the technology by learning about other people's use of the technology. They learned from others by observation, by asking others for help, or through dedicated trainings. Through these actions, they became aware of the possibility of using SP for a purpose meaningful to them. We refer to this process as imitating because users perceive how they can imitate another person's use. For example, Stuart gave a short induction to Susan, in which he showed her how to use the versioning-comment feature of SP to keep records of changes in a document. Susan, whose responsibility was to coordinate production planning with a number of colleagues, then became aware of the affordance of using the versioning-comment feature to coordinate production planning with her colleagues. She said, "The versioning comments are important for us to track changes … We just repeated what [Stuart] has shown to us and implemented it." Hence, she perceived the affordance that the versioning-comment feature offered for the purpose of coordinating production planning. She perceived this affordance by imitating the use that Stuart had demonstrated.

Exploring. Some users perceived possibilities to use SP for a specific purpose by exploring SP on their own. They roamed through menus and settings of SP to find features that they could potentially use. Users interpreted the symbolic expressions of SP (i.e., what the "artifact communicates to its users" (Bernhard et al. 2013, p. 5)) and linked the results of this interpretation process to the purposes for which they intended to use SP. We refer to this process as exploring because users are searching the technology for new potential uses. For example, Marvin, who worked as a project manager in Alpha's customer care department, searched for ways to gather and compare status information about current projects. In the SP menus, he found the survey app, a feature that allows users to run surveys: "I saw that there are apps and that there is a survey app. You could start a poll. [Gathering and comparing status information about projects] is really an issue for which one can use this app." Thus, he concluded from the name of the app (i.e., a symbolic expression) that it would provide survey functionality. He perceived that he could use the survey app "for benchmarks", (i.e., for gathering and comparing information about project status). This is an example of exploring as Marvin found the survey app on his own and realized a potential use from the description of the app.

Transferring. Sometimes users perceived possibilities to use SP for new specific purposes by reapplying their existing (current or previous) ways of using SP for a new purpose. These users typically built on their experiences with SP and became aware that they could use SP for a new purpose. We refer to this process as transferring because the users transfer their existing use of the technology to a new context. For instance, George, a quality manager, was responsible for organizing technical norms, i.e., for storing the current technical norm documents and making them accessible to users. He intended to provide colleagues with information only on those norms that were relevant to them. Being familiar with the extensive filter feature from his prior use of SP, he perceived a way to provide colleagues with only relevant norms: "It would be great if the filter is set automatically when you log in with your account depending on your department." Hence, he realized that he could use the extensive filter feature to provide personalized views on norms. This is an example of transferring because George was already familiar with the use of the filter feature and transferred that knowledge to a new purpose.

Process	Background Information	Coding Examples
Imitating	1. Susan and Stacey talked about their use of SP. Stacey showed Susan that her team uses SP to track open issues. Susan recognized that her team could also use SP to track open issues.	**Susan:** "I talked to Stacey about her SP use. … The idea arose to collect open issues of our team meetings too."
	2. Marti learned that Stuart used wiki pages in SP to share information about upcoming events. Stuart recognized that he could also use wiki pages in SP to share information about events.	**Marti:** "[Stuart] built a wiki page for an event … I think that is really cool … that could fit for my own project."
Exploring	1. Marvin explored SP to become familiar with its features. In the app overview, he discovered the "survey app". He suspected that the survey app might allow him to conduct benchmark surveys across projects.	**Marvin:** "I saw many apps [in SP] also for surveys. You could start a survey. We conduct benchmark surveys… We could give it a try."
	2. Ulf managed a community of engineers that shared and discussed technical news. He searched for a way to enable the community to rate content. He explored the menus and found the rating feature. Ulf had to decide between the liking and star rating option.	**Ulf:** "I activated [the] liking [feature] … I first thought about using a star rating, but that is complicated, so I tried liking."

Transfer-ring	1. George used SP to make information about technical norms available at a central place. Later, he identified a problem with document templates at Alpha. Employees used outdated templates because the templates were not stored in a central place. George perceived that SP would allow storing templates at a central place, much like in his existing use of SP for managing technical norms.	**George:** "I told them … templates are not different from other documents. … These templates I want to have in SP to steer it."
	2. Marti used SP to store project related documents. Later he became responsible for production planning. Since he was familiar with the document management capabilities of SP, he also used them to make production planning documents available.	**Marti:** "We now also store our production planning documents on SP."

Table II-2 Example Quotes of Perception Processes

4.1.2 Affordance Actualization Processes

Users engaged in a variety of processes to actualize the perceived affordances. Affordance actualization processes often consisted of two steps: configuration and initial use. Many affordances required, in a first step, that someone configured SP (e.g., by changing parameters in SP) in such a way that the conceived use was possible. While many affordances required configuration, this was not true for all of them. Some affordances could be actualized without configuration because the features were ready to use. Irrespective of whether configuration was required or not, an affordance was only actualized with its initial use. Our data analysis showed that affordance actualization processes differed in particular in the way in which the configuration was performed. We observed three categories of configuration processes: delegated, guided, and autonomous configuration. Table II-3 shows the definitions of these processes. Table II-4 provides example quotes of configuration processes and initial use.

Process	Description
Delegated Configuration	Another person configures the technology based on the user's requirements.
Guided Configuration	A user configures the technology under step-by-step guidance provided by another person.
Autonomous Configuration	A user configures the technology without step-by-step guidance provided by another person.

Table II-3 Definitions of Affordance Configuration Processes

Delegated Configuration. Users sometimes delegated the configuration of SP to others, often to someone with stronger knowledge of SP. Users typically informed these people about the goal they wanted to achieve. We refer to this process as delegated configuration because another person performs the configuration work on the user's behalf. For instance, George intended to set up the norms repository but did not know how to do so in SP. Thus, he contacted Stuart and described his requirements to him: "I made up my mind what I wanted to achieve. Then I went to Stuart and discussed my requirements with him. … [Stuart] then created the site based on my inputs." In this example of delegation, George bridged his missing knowledge by having the configuration work done by Stuart.

Guided Configuration. In some instances, users were guided by others through the configuration of SP. The users described the intended use to the other person, who typically had greater SP knowledge. The other person then led the user step-by-step through the configuration. Typically, both users sat in front of a computer, or shared a screen in a video conference, and the guiding person helped the guided user with where to click and what to enter. We refer to this process as guided configuration. One example is Susan's use of SP for managing meetings. After she had observed how another colleague tracked issues and open questions of meetings (i.e., perception by imitating), she wanted to use the same features to manage her meetings. Since she did not know how to configure SP for this purpose, she asked an expert, who showed her how to set up a list for her identified purpose. The expert told her what to do and asked clarifying questions during the process. Susan executed the configurations by herself. This is an example of guided configuration because Susan executed the configuration on her own based on the instructions provided by the expert.

Autonomous Configuration. Users also configured SP on their own. Although they may have obtained help from others or through documents, they executed the configuration autonomously (i.e., without step-by-step instructions provided by others). We refer to this process as autonomous configuration given that the users executed the configuration on their own. For instance, Ulf intended to establish an efficient way in which users would be able to share interesting news articles on a portal. He configured a library in SP to receive emails and automatically store the attachments in the library: "I also tested [organizing the news portal] with libraries and email accounts. This was received pretty well." He executed the configuration on his own based on his knowledge of SP.

Process	Background Information	Coding Examples
Delegated Configuration	1. George knew about SP capabilities and planned to use them to make information about norms available. However, he was not familiar with the set-up of SP at Alpha. Thus, he described his requirements to Stuart and urged him to set up a site. Stuart created the site and performed the initial configuration.	**George:** "This site has existed for much longer. Stuart created it for me and I just uploaded the documents … I cannot create sites. I also do not want to, because I do not know whether I do it right."
	2. Pete was Marti's manager and used SP. His project sites needed a special template to match his requirements. He delegated the configuration of his project sites to the IT support team.	**Pete:** "I know the people who are good at SP and get their help. That is faster than trying for hours on your own."
Guided Configuration	1. Marvin intended to incorporate Gantt charts in his project management tasks. When he had questions regarding how to configure SP to this end, he asked Stuart. Stuart showed him how to configure SP for this purpose.	**Marvin:** "If I have a problem [configuring SP]… I go to Stuart and he shows me how to do it."
	2. George executed many configurations on his norm repository. For example, he	**George:** "I later shared my screen in a video call

	had to structure the library. In the beginning, he asked Stuart to guide him through the configurations. They shared their screen in a video call and Stuart told him what to do.	with [Stuart], and then he could guide me, telling me what to do. He led me through the configuration.”
Autonomous Configuration	1. Ulf wanted to restrict permissions in his reporting tool to prevent false deletions. Therefore, he modified the permissions on his own and removed the permission to delete items for certain users.	**Ulf:** “I often configure the permissions and remove the delete permission for certain users.”
	2. Marti was responsible for the production planning documents. He configured all changes on his own. For example, he added additional columns to structure the documents.	**Marti:** “I configure modifications on my own. Thus, if there are any modifications, I just do them.”
Initial Use	1. Susan configured the check-in/out feature in SP. She explained the feature to her colleagues and now they use it to manage documents.	**Susan:** “I use this with my colleagues in China. We sometimes have problems with this [check-in/out].”
	2. Marti configured event sites to store information about events in his projects. His colleagues used these sites to search for information.	**Marti:** “We implemented an event site … that works pretty well. The colleagues like it too.”

Table II-4 Example Quotes of Actualization Processes

4.2 Sequences of Affordance Actualization Processes

Using the categories introduced above, Table II-5 shows the affordance perception (see the upper segment of the table) and configuration processes (see the lower segment of the table) in which the five users in the focus of our study engaged over time. We next provide detailed accounts of two cases, George and Susan, to illustrate typical but different patterns of processes over time.

4.2.1 George

George was the head of quality management at Alpha. When George first learned about the implementation of SP at Alpha, he was curious: "… from my experience from my old organization I thought: 'That is great.' Seven years ago this already was a good product; meanwhile it has surely evolved." However, because of this evolution and the different set-up of SP at Alpha, he "did not understand it anymore". Therefore, he decided to search for help and found support in Stuart, who was the project manager of the SP project and who was eager to promote the use of SP at Alpha. George intended to set up a repository for technical norms that would allow him to share information about these norms within Alpha. He knew from his experience that he could use SP to make documents available *(affordance perception by transferring)*. However, he needed Stuart to configure the site in SP. He described the situation when approaching Stuart for the first time: "When I first contacted Stuart, I made up my mind what I wanted to achieve. Then I went to Stuart and discussed my requirements with him. … [Stuart] then created the site based on my inputs." Thus, Stuart configured SP based on George's requirements *(delegated configuration)*. Later in the same session, Stuart also showed George how to use metadata (i.e., attributes of documents stored on SP) to provide users only with norms relevant to them. George was skeptical, "In the beginning I was not sure, why he did not follow my suggestions", but followed Stuart's advice: "But then I let it happen. … I just followed his advice and accepted it." Thus, George perceived the possibility to structure documents based on the use shown by Stuart *(affordance perception by imitating)*, and Stuart configured the initial set-up *(delegated configuration)*.

Afterward, they continued working on this site in a number of sessions. They shared their screens in video calls, in which Stuart guided George through the configuration *(guided configuration)*. During these sessions, George wanted to learn about SP because he had "personal interest" in SP and because he wanted to become autonomous: "Right now my problem is that I depend on others. … I want to become an excellent user for my own needs, and I want to control what I do and become autonomous."

<table>
<tr><th>User</th><th>Nov 2014</th><th>Mar 2015</th><th>Jul 2015</th><th>Jan 2016</th><th>Mar 2016</th><th>Aug 2016</th><th>Jan 2017</th></tr>
<tr><td colspan="8">Affordance Perception Processes</td></tr>
<tr><td rowspan="2">George</td><td>Imitating</td><td colspan="4"></td><td colspan="2" rowspan="2">User left organization</td></tr>
<tr><td colspan="5">Transferring</td></tr>
<tr><td>Susan</td><td colspan="3">Imitating</td><td colspan="2"></td><td colspan="2">User left organization</td></tr>
<tr><td rowspan="2">Ulf</td><td colspan="3">Exploring</td><td colspan="4"></td></tr>
<tr><td colspan="7">Transferring</td></tr>
<tr><td rowspan="3">Marvin</td><td colspan="2">Imitating</td><td colspan="5"></td></tr>
<tr><td colspan="2">Exploring</td><td colspan="5"></td></tr>
<tr><td colspan="4"></td><td colspan="3">Transferring</td></tr>
<tr><td rowspan="2">Marti</td><td colspan="2">Imitating</td><td colspan="5"></td></tr>
<tr><td colspan="4"></td><td colspan="2">Transferring</td><td></td></tr>
<tr><td colspan="8">Configuration Processes (Part of Affordance Actualization Processes)</td></tr>
<tr><td rowspan="3">George</td><td>Delegated</td><td colspan="4"></td><td colspan="2" rowspan="3">User left organization</td></tr>
<tr><td colspan="5">Guided</td></tr>
<tr><td colspan="3"></td><td colspan="2">Autonomous</td></tr>
<tr><td>Susan</td><td colspan="2"></td><td>Guided</td><td colspan="2"></td><td colspan="2">User left organization</td></tr>
<tr><td>Ulf</td><td colspan="7">Autonomous</td></tr>
<tr><td rowspan="2">Marvin</td><td colspan="2">Guided</td><td colspan="4"></td><td>Guided</td></tr>
<tr><td colspan="4"></td><td colspan="3">Autonomous</td></tr>
<tr><td rowspan="2">Marti</td><td></td><td>Guided</td><td colspan="5"></td></tr>
<tr><td colspan="4"></td><td colspan="2">Autonomous</td><td></td></tr>
</table>

Table II-5 Affordance Actualization Sequences for Users

During the subsequent time, Stuart was not always available for help, but George still did not feel confident enough to configure SP on his own. Therefore, George sought help from the IT department. However, his first experiences were devastating: “There [at the IT department] I made a request three or four weeks ago. … Chris [the SP administrator at Alpha] told me he would come to me for a training, but he did not come. … Since then I’ve never heard a word from them.” The IT department had scarce resources and could not support the SP requests. Given the limited support from others and limited confidence in his own abilities, George struggled to actualize new affordances based on SP during that period.

After this episode, George increased the pressure on Stuart, insisting that Stuart should assist him with the configurations required to actualize a number of new affordances that George had perceived. Stuart agreed to assist him. George later described this joint work with Stuart as a “perfect start”. One of the ways in which Stuart assisted was to make summaries of George’s quality management meetings accessible to management. He said, “I do not want to send a document to [managers from other departments] but a link to SP with an image and one or two sentences. … They should open it on their mobile phones and get an impression.” George had perceived the possibility of using SP for this purpose on his own *(affordance perception by transferring)*; however, he depended on Stuart to guide him through the configuration process *(guided configuration)*: "Stuart showed me how I can do this." Another of George's purposes at this time was to set up a process management repository (i.e., centrally stored descriptions of different business processes and their attributes). This actualization followed a similar pattern: Drawing on his experiences with the norms repository, George perceived that he could use SP to make process management information available to users *(affordance perception by transferring).* Stuart showed him how to create the required list and columns in SP *(guided configuration).*

The frequent guided sessions positively influenced George's knowledge. George was now able to configure some features on his own: "If there is a missing column, I can add it. Or the configuration of a column or list, that I can do as well." However, he still did not feel confident enough with other features of SP: "… I cannot create new sites or modify the layout. I also do not want to do so because I have no training and do not know if I am doing it right." He demanded more trainings and documentation: "One of the biggest issues is that you cannot use [SP] because there have been no trainings and we have nobody in the organization who can handle it." A setback for George was when Stuart left Alpha in late 2015. Despite these problems, George continued his existing uses and even actualized new affordances with SP. A new purpose was to make standard document templates available to users. Based on his knowledge of SP, he perceived how SP could be used for this purpose *(affordance perception by transferring)*: "We need the possibility to add metadata to the documents with all variable information, like logo or directors. … If something needs to be changed, we can easily filter the metadata to find the needed documents." He configured the site on his own, without help *(autonomous configuration).*

In summary, although George initially perceived some affordances by imitating, he perceived many affordances by transferring. Drawing on this basic knowledge of SP gained during his prior job, he was able to recognize how to transfer these familiar ways of using SP to purposes relevant to his current job. Nevertheless, he depended on help in order to make the required configuration changes. Being eager to learn how to change the technology, he preferred guided configuration processes, in which he could learn how to perform the desired configuration. Based on the knowledge gained during guided configurations, he was able to complete smaller configurations on his own.

4.2.2 Susan

Susan was a member of the production planning team. Susan and her team were searching for a tool to support coordination during production planning: "We said we would like to have a planning tool. But then everybody told us about SP … So we said we will take a look at SP to find out whether it provides what we need." Susan's first contact with SP was when she requested an induction session from Stuart. At this point, she and her colleagues did not know anything about SP: "We are absolute beginners." From the example uses shown in the induction session, Susan recognized that they might be able to use SP to coordinate work in their distributed teams *(affordance perception by imitating)*: "We work across borders and need to store documents centrally. … In the future, we want to use SP in all projects because the team members are always located in different locations." She decided to use the machine reservation process as a pilot. In this process, Susan and her colleagues shared information about machine availability and open orders through a central document, which was continuously updated by different users. Previously, the document was sent back and forth via email, which sometimes led to inconsistencies between versions. With SP, they were able to make the document available in one central location, allowing the team to track the changes between different versions of the document. No configuration work was required for SP to store this document in a central place and manage its versions. To actualize the affordance of performing the machine reservation process with a central document, Susan needed to educate the other people involved in this process about the new way of performing it. To this end, Susan wrote a manual: "I wrote a short manual. The focus was only on our document and how to check it in and out."

At that time, Susan did not benefit from the opportunity of observing other people's use of SP. In her office, she was the only user of SP besides one secretary, Stacey, who worked in another department. Her main contact was Stuart, who was not available all the time and who only helped on request. She later summarized the experience this way: "I never got any input from the IT department. … Stuart gave us an induction and said there would be trainings. However, the trainings never came. And now Stuart is also gone." Thus, for some time, the enhanced machine reservation process was the only affordance actualized with SP.

After some time, Susan was offered a SP consulting session with a SP expert. Until that point, she had perceived two affordances but was unsure of how to perform the configuration work required to actualize these affordances. During the session with the expert, she performed the configuration changes under the guidance of the expert. The first affordance was to manage open issues in her meetings. Susan had perceived this affordance from Stacey's use of SP *(affordance perception by imitating)*: "[Stacey] sent me an email with a link to her site [where she tracked open issues of meetings]. I then had the idea to also set up a list with tasks, due dates and so on." However, Susan lacked the knowledge of how to configure such a list. In the consulting session, the expert guided her on how to configure this list *(guided configuration)*. This subsequently enabled Susan and her colleagues to collect open points from a recurring meeting at a central place. The second affordance was related to the machine reservation process. Her goal was for everyone to be automatically informed about changes to machine reservations. From Stuart's induction session, she recalled that the alert feature could be used this way *(affordance perception by imitating)*. Following that perception, she had planned to make use of this feature, but she did not know how to do so. The expert guided her through this configuration *(guided configuration)*. After this workshop, Susan "felt more confident with SP." All actualizations in this workshop were based on information from others (Stacey and Stuart) and could only be realized with the help of the expert. She continued using her central use case (i.e., the document in the machine reservation process) but did not actualize further affordances.

In summary, Susan, who lacked prior experience with SP, only perceived affordances by imitating other's use of SP. One affordance did not require configuration to be actualized. This affordance could be actualized after Susan educated the people involved in the collaborative use on how to use SP. Other affordances required configuration changes before their initial use. Susan was able to actualize these affordances only after an expert was available to guide her through the configuration. In total, Susan perceived and actualized relatively few affordances offered by SP.

4.3 Necessary Conditions

The two accounts of George and Susan, and the five cases summarized in Table II-5, show important differences in the ways users perceived and actualized affordances. We next propose an emergent theory to explain why users engaged in these different processes. Figure II-1 shows this emergent theory. The figure shows the necessary conditions for particular affordance perception processes and for particular configuration processes. Table II-6 shows more specifically which necessary conditions, as proposed by us, need to be present for particular processes to occur. The necessary conditions help to explain not only why processes differed between cases but also why processes were sometimes stuck. We next illustrate these necessary conditions primarily based on the cases of George and Susan, including examples of affordance actualization processes that were stuck for at least some period of time.

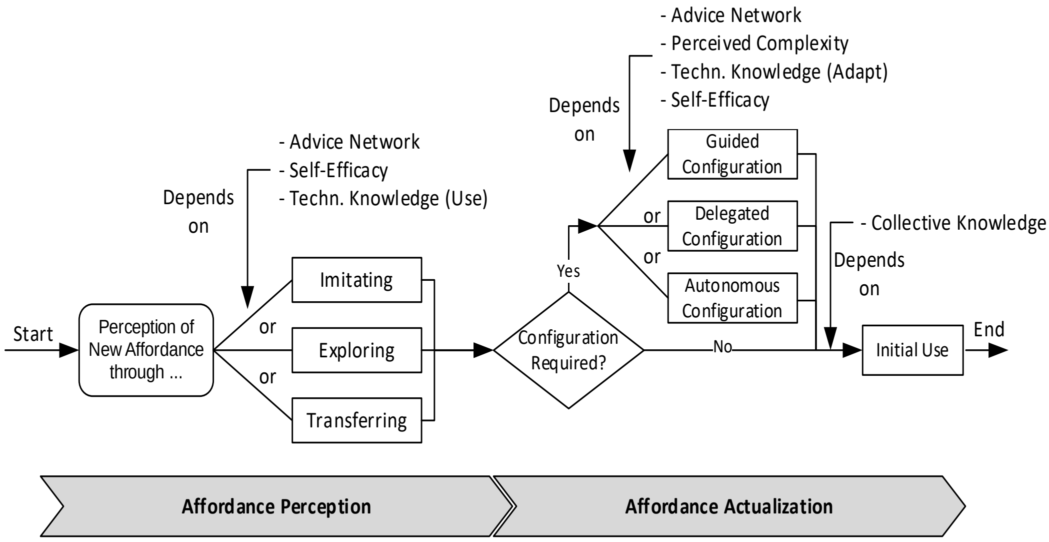


Figure II-1 Affordance Actualization Process and Influencing Factors

4.3.1 Affordance Perception Processes

Imitating Depends on Advice Networks. George and Susan initially perceived several affordances through imitating. An important and necessary condition for imitating was that the users were embedded in networks in which they had opportunities to learn about other's use. In line with the existing literature, we refer to these networks as *advice networks* (e.g., Gibbons 2004), which are relationships between users through which users seek and exchange information, advice, and possibilities for solving problems. For example, the relationship with Stuart initially provided an important source of advice for both George and Susan as Stuart showed them the possibilities of SP at Alpha. For example, George perceived from his interactions with Stuart how he could use metadata to organize a document repository. Susan perceived from the interactions with Stuart how she could leverage the versioning of documents in SP. In both cases, the users repeated what was shown to them, as Susan said: "What he has shown to us, we used." Another example was the relationship between Susan and Stacey. Susan perceived from her exchange with Stacey how she could use a list herself to track open issues in recurrent meetings. Interestingly, in this case, the relationship was not the relationship between an expert (e.g., Stuart) and an ordinary user but rather between two users at the same expertise level.

Table II-5 shows that imitating was particularly prevalent at the start of the post-implementation phase. Imitating was therefore a frequent strategy at a time when users lacked knowledge about possible uses of SP and when they were not confident enough to explore SP on their own. Hence, unlike the other two perception processes, imitating allowed even users with low knowledge and low confidence to recognize ways in which they could use SP for their work.

Process	Necessary Conditions
Imitating	Advice Networks
Exploring	Self-efficacy to Use
Transferring	Knowledge to Use
Guided Configuration	Advice Network
Delegated Configuration	Advice Network & Perceived Complexity
Autonomous Configuration	Self-Efficacy to Configure & Knowledge to Configure
Initial Use	Collective Knowledge (Use)

Table II-6 Affordance Actualization Process Phases and Necessary Conditions

Exploring Depends on Self-Efficacy. Relatively few users engaged in exploring. George and Susan did not engage in this process because they felt insecure: “I am still afraid of changing something because I could destroy the site if I play around too much.” (George, fifth interview). In contrast, those users that engaged in exploring believed that they were able to find new possibilities to use SP. In the literature, the belief of being able to execute a task successfully is often referred to as self-efficacy (e.g., Bandura 1977). Our data suggests that self-efficacy is a necessary condition for exploring. Marvin, a project manager, had high self-efficacy and explored SP: “… Learning by doing, trial and error. It either works out or not. This [strategy] works pretty well.” He was not afraid of damaging something but was instead fascinated by the options SP was providing: “First you observe the tool: ‘Ah this and that is possible,’ and you find a ton of functionalities.” Although self-efficacy was a necessary condition, high self-efficacy did not imply that users were constantly exploring. For instance, Marvin explored in the beginning, but after a while, he stopped exploring and focused instead on the uses of SP with which he was familiar at that time.

Transferring Depends on Knowledge to Use. George perceived many affordances through transferring, whereas Susan did not perceive any affordances through transferring. This difference can be attributed to a key necessary condition for transferring: knowledge of the use of SP. George had basic knowledge of the use of SP from his prior job, and he extended this knowledge as he continued to actualize new affordances with SP. We refer to this as knowledge to use that is the knowledge users gain by using SP for different purposes over time. For example, George had built up his norm repository with Stuart. Therefore, he knew that documents could be stored and organized with SP. Later, he had the goal of storing document templates centrally. Based on his experience he realized that he could actualize this affordance with SP as well: "I told them … templates are not different from other documents. … I want to have these templates in SP in order to control them." Thus, George transferred a previous use case (i.e., organizing a norm repository) to a new one (i.e., organizing document templates). George engaged in transferring from the beginning, since he knew SP from his previous organization and knew its potential: "When I remember back [to my previous organization], the others were impressed with what I could do with SP." With each further actualized affordance, he extended his knowledge making it more likely that he could transfer his knowledge to a new use case. Thus, a certain amount of experience is needed to gather enough knowledge to use. Susan, in contrast, did not perceive any affordances by transferring. Lacking prior experience and using SP only to a limited extent, she did not acquire enough knowledge to use. She did not use the system intensively: "We just let things slide and are not intensively involved [in using SP]. … I really do not have many ideas of what we could do with SP." (second interview); "We just worked with the list [machine reservation] but have not created anything new" (third interview); "We do not use [SP] frequently; that is not going to make it easier." (fourth interview). Therefore, she did not fulfill the necessary condition for transferring.

4.3.2 Affordance Actualization Processes

Guided Configuration Depends on Advice Networks. George and Susan were both guided in at least one instance of an affordance actualization. An important necessary condition for guidance to occur was that a guide (i.e., a person with sufficient knowledge to guide the user through a specific configuration) was willing to help. In our case study, all guides were part of the advice network of the user. Thus, it appears that advice networks are a necessary condition for guided configuration. For example, Stuart repeatedly guided George: “And [the norm repository] is what I am currently working on with Stuart. He gives me exercises and then we meet and realize something. That is working fine.” After Stuart’s departure, George relied on another relationship from his advice network, namely, the relationship with an external SP expert. The same external SP expert also supported Susan’s guided configurations in the training sessions. Guided configuration produced increases in knowledge because it allowed users to experience how to configure the technology.

Delegated Configuration Depends on Perceived Complexity and Advice Network. George delegated configuration on one occasion, whereas Susan never delegated configuration. This difference may be explained by two necessary conditions: high perceived complexity (i.e., the user perception that the configuration task is very complex) and the presence of an advice network. For example, George delegated the initial creation of his norm repository site to Stuart: “When I first contacted Stuart, I made up my mind what I wanted to achieve. Then I went to Stuart and discussed my requirements with him. … [Stuart] then created the site based on my inputs.” George perceived the initial creation as complex because it included the site creation and modifications in layout: “… I cannot create new sites or modify the layout. I also do not want to do so because I have no training and do not know if I am doing it right.” Therefore, after the initial discussion, he delegated the configuration to Stuart. This required that Stuart be part of his advice network (i.e., that he could delegate the configuration to him). Susan did not delegate configurations because she did not perceive any affordances that would require complex configurations and lacked a strong advice network.

Autonomous Configuration Depends on Knowledge to Adapt and Self-Efficacy. Except for Susan, all observed users engaged in autonomous configurations. The necessary conditions for autonomous configurations were that the users had sufficient knowledge to adapt and had sufficient self-efficacy (i.e., they believed that they were able to execute the configuration successfully). For example, George configured his template repository on his own only after he had previously configured smaller changes: “I can configure a column or a dropdown if needed.” Although George had low self-efficacy regarding the use of some features, he had high self-efficacy regarding the use of other features, such as columns. The reason for this was that he had repeatedly engaged in guided configurations in which he configured these functions again and again. Thus, for these specific configurations, he had high self-efficacy, whereas in general he showed relatively low self-efficacy. Furthermore, he also had the knowledge to configure the specific features.

Initial Use Depends on Collective Knowledge. Our data analysis points to one necessary condition of the last step in the affordance actualization process: initial use. Initial use required that other users that had not been involved in the actualization process before but that should participate in the collaborative use of SP, understand how to use the configured artifact. For example, Susan addressed this condition by creating a manual for her colleagues: “I wrote a short manual. The focus was only on our document and how to check it in and out.” The problem was that users that were not involved before but that were also involved in the machine reservation process, had no knowledge about SP. Users did not know of SP or did not know enough to use the created artifacts. In the chosen setting, a collaborative environment, the use scenarios required that all users that should participate in the collaborative use scenario had sufficient knowledge. We refer to this as collective knowledge (i.e., knowledge that the users needed to collectively possess).

4.3.3 When Affordance Actualization Processes Were Stuck

The necessary conditions help to explain why not all affordance perceptions culminated in affordance actualizations. Specifically, after the initial perception of an affordance, there were two phases in which the actualization of the affordance sometimes remained stuck: (1) between perception and configuration and (2) between configuration and initial use. An example of the first category is Marvin’s attempt to use the survey feature. Marvin had never configured a survey with SP, although he perceived the possibility to do project reporting with the survey feature. Surveys in SP require configuration. Since Marvin did not have the knowledge to configure surveys, autonomous configuration was not possible (no knowledge to adapt). Furthermore, no one in his advice networks used surveys in SP; thus, there was no one who could guide Marvin through the configuration or to whom Marvin could have delegated the configuration (no person with sufficient knowledge in the advice network). Since the necessary conditions for autonomous, delegated, and guided configuration were not met, Marvin could not arrange for configuration and, hence, could not actualize this affordance. An example for the second phase was an affordance actualization attempt by Ulf. Ulf had to collect activity reports from several users. To reduce his efforts, he configured a SP list that contained the needed fields. Then he sent an email to the users with a link to the list and requested that they enter their activities in the list. Although some users successfully added their activities, many failed and replied to Ulf with the activities written in emails. Ulf sarcastically noted, "An email with texts and I can enter them manually. Perfect." The result of this affordance actualization attempt was that Ulf could not collect activities with his SP list. Thus, the perceived affordance was ultimately not actualized because not all users had the required knowledge and the necessary condition (of collective knowledge) was not met.

5 Discussion

This paper was motivated by the lack of knowledge about the processes through which users realize the potentials for action, or affordances, offered by collaboration platforms. To address this gap, we conducted an exploratory case study of affordance actualization processes on collaboration platforms. We found that affordances are actualized through a three-step process. In the first step, users perceive affordances by imitating, exploring, or transferring. In the second step, users often (but not always) need to arrange for configuration, which may occur in delegated, guided, or autonomous ways. In the third step, the collective of users involved in the collaborative task starts using the platform in the conceived way. Our emerging theory suggests that the occurrence of particular processes is contingent on user characteristics (self-efficacy, perceived complexity, and knowledge) and on external factors (advice networks and collective knowledge). Vice versa, user characteristics (e.g., knowledge) are also influenced over time by affordance actualization processes, which may enable different affordance actualization processes over time.

5.1 Contributions

Our research contributes to the literature on technology affordances, feature use, and collaboration platforms by (1) proposing a taxonomy of and explanations for affordance perception processes, (2) introducing configuration as an important phase in the affordance actualization process, and (3) analyzing the affordance actualization processes of generic features in collaboration platforms over time.

The existing literature provides limited insights into the variety of processes that lead to *affordance perception*. For instance, Leonardi noted that “perceptions of affordance lead people to change their routines” (Leonardi 2011, p. 147), but he did not inquire how and when these perceptions arise. Other scholars (e.g., Bernhard et al. 2013; Markus and Silver 2008) were more explicit about the role of information in affordance perceptions when they argued that users may perceive affordances from external information or from the symbolic expressions of the technology. Yet, these scholars were less explicit about the processes through which users obtain this information and about the conditions under which users engage in these processes. Research on feature use (e.g., Maruping and Magni 2015), in turn, has examined one particular affordance perception process, exploring, and the conditions, such as team empowerment, under which users engage in this exploring. However, in line with the focus, this research has not examined affordance perception processes beyond exploring. Our study reveals that not only exploring but also imitating and transferring can result in affordance perception. Much like many roads do lead to Rome, several alternative processes can result in the perception of an affordance. Importantly, although these processes produce the same outcome (i.e., the perception of an affordance), they depend on different necessary conditions. Imitating requires advice networks, transferring requires knowledge to use, and exploring requires self-efficacy. This implies that people can perceive new affordances even when the necessary conditions for one or even two perception processes are not met. For instance, when users lack the self-efficacy required for exploring and the knowledge required for transferring, they may nonetheless draw on their advice networks to imitate other people’s uses. In sum, our study proposes a taxonomy of affordance perception processes and explanations for their occurrence in the context of collaboration platform use. We believe that this is an important step toward more fully explaining how and when users perceive affordances from collaboration platforms.

Our second contribution is the incorporation of *configuration* into affordance actualization processes in the context of collaboration platforms. Configuration is largely absent from many current conceptualizations of the affordance actualization process (Bernhard et al. 2013; Strong et al. 2014). Indeed, configuration may not be an essential element of affordance actualization processes in the context of IT in that is hard-to-change, such as relatively rigid software packages that do not allow for much customization. In such settings, users may merely start using what the IT already offers.

In contrast to such rigid IT, collaboration platforms are highly malleable (Kallinikos et al. 2013). They invite users not only to perceive action potentials but also to configure the platform in such a way that the actions become possible. Our findings show that it is problematic to omit configuration from the affordance actualization process. In the cases that we studied, configuration was often an obstacle that prevented users from actualizing affordances. Thus, configuration processes are an important element if one aims to explain how and when users realize the full potential from collaboration platforms. Our results not only point to the importance of configuration, but also reveal three alternative processes through which users can arrange for configuration: delegated, guided, and autonomous configuration. Like our uncovered affordance perception processes, the three configuration processes yield the same outcome (i.e., the collaboration platform is ready for the conceived use) but rely on different necessary conditions. Hence, users may arrange for configuration even if the prerequisites for one or two configuration processes are not met. For instance, when users lack the knowledge and self-efficacy required for autonomous configuration, they can still draw on their advice networks and ask peers to guide them through the configuration process. In conclusion, we contribute to a more nuanced perspective on affordance actualization processes in the context of collaboration platforms by incorporating different types of configuration processes and explanations for their occurrence.

The third contribution is the longitudinal perspective on affordance perception and actualization processes in the context of collaboration platforms. Although the literature has recently begun to explore sequences of affordance actualization processes (Strong et al. 2014), this work has not yet examined whether and how affordance perception and actualization processes change over time. Our findings show that as users gain knowledge and self-efficacy through their initial affordance perceptions and actualizations, over time, this enables new types of affordance perceptions and actualizations. Specifically, whereas users often initially perceived affordances by imitating, they increasingly perceived affordances by transferring as their knowledge grew due to affordance actualizations. Moreover, they were increasingly able to autonomously make the configuration changes required to actualize these perceived affordances. These findings may be specific to collaboration platforms, and perhaps other types of highly malleable IT, where users can utilize the same features to actualize a variety of affordances over time. In such contexts, users can increasingly draw on their knowledge of the generic features with which they become more and more familiar to invent and independently implement new uses for these features.

5.2 Future Research

The identified affordance actualization processes open up new avenues for research. Future research could look in greater detail at imitating and transferring both of which are affordance perception processes that have been less frequently examined in the literature. Alternatively, a broad study could include all types of affordance perception and configuration processes in one integrated study in order to explain the various conditions and processes through which users ultimately actualize affordances. Another avenue for future research is more case studies that examine affordance actualizations in collaboration platforms. Such case studies might reveal further processes not uncovered in this study. Such case studies could also help to validate the identified mechanisms and influencing factors. The presented sequences of affordance actualization processes also require further research. Although our study points to knowledge and self-efficacy as important factors for these dynamics, their interplay needs further analysis. Another avenue for future research is the lasting impact of affordance actualizations in collaboration platforms. During our study, some users left the organizations and left behind artifacts they had configured to actualize affordances. Other users continued some of these affordances, but some artifacts only remained as legacy and unused. The factors, when affordance actualizations have a lasting impact and are imbricated in routines (Leonardi 2011), require further analysis. This would deepen our understanding of how affordance actualization could result not only in immediate but also sustained outcomes. Furthermore, more studies should focus on the perspective of generic features and their use for collaboration platforms.

5.3 Practical Implications

For praxis, our findings help to support the post-implementation phase of collaboration platforms by providing a detailed view on how users actualize affordances. Organizations can use this information to enable their users to actualize affordances. From a temporal perspective, our findings suggest that users will mostly perceive affordances through imitating in the beginning. Thus, organizations should facilitate advice networks to meet the necessary conditions for imitating. Therefore, key users should be enabled to promote the collaboration platform. These key users should be trained to gain knowledge about the platform, be given discretion to support and train others as well as actualize affordances on their own. The selection of key users should incorporate their self-efficacy. Key users with high self-efficacy are more likely to explore the platform and perceive new affordances through this exploration. The forming of advice networks will not only support affordance perception through imitating but also configuring through guided configurations, which also depends on advice networks. In later phases, our data suggests that the role of advice networks diminishes, since users more often engage in transferring to perceive new affordances instead of imitating. The users can gain the required knowledge to use in the initial phase through participating in actualizing affordances with others. Managers can foster ongoing affordance perception and actualization in later phases by encouraging users to utilize and configure the collaboration platform on their own (Jasperson et al. 2005). This may strengthen the self-efficacy of users and lead to autonomous configurations. If configuration remains a widespread obstacle, because users and their advice networks lack the knowledge to configure, organizations can provide active offerings to execute configuration (i.e., delegated configurations). These offerings can be provided by "facilitators" or "chauffeurs" (i.e., experts trained to implement artifacts on the collaboration platform) (Kolfschoten et al. 2012). These experts can also diffuse examples of affordance actualizations, which will support transferring and imitating. Furthermore, organizations should preclude problems in the initial use phase through missing collective knowledge. Therefore, all users should have a basic understanding of SP (Gallivan et al. 2005). Organizations should provide a basic training for this. Nevertheless, users that actualize affordances should also be directed to provide guidelines and information for participating users on how they should use the created artifact. All of our findings focus on collaboration platforms with low restrictiveness; high restrictiveness may require other strategies (DeSanctis et al. 2008).

5.4 Limitations

Our study has some limitations. First, we only observed the affordance actualization processes in one organization in a specific scenario and analyzed only a small set of users. It may be that other affordance actualization processes exist for collaboration platforms, but did not occur in our data collection. Future research can explore this. Additionally, it is important to acknowledge some specific conditions of our empirical setting. Alpha postponed trainings for SP until summer 2016 one and a half years after the planned go-live. These trainings had only a marginal impact on our observed users, since they already had acquired the needed knowledge. In scenarios with an official training in the beginning, other results may occur; such trainings may influence the technological frame (Leonardi 2013) or could limit the users to only use specific possibilities of SP. In addition, the open policies applied by the IT department invited configuration by end users. In other scenarios, more restrictive policies (DeSanctis et al. 2008) may suffocate configurations and lead to different dynamics that are more comparable to existing affordance actualization literature (Leonardi 2013; Strong et al. 2014) respectively standardized use (Saga and Zmud 1994). We also did not focus on the negative aspects of the open policy, such as inertia or reinventions (Boudreau and Robey 2005), for the organization, which may lead to performance loss.

STUDY 2 EXPLAINING DIFFERENCES IN AFFORDANCE PERCEPTION UNDER MALLEABLE INFORMATION TECHNOLOGY: A SOCIAL COGNITIVE THEORY PERSPECTIVE

Tim Lehrig, Oliver Krancher

Abstract

Malleable technologies contain generic functionalities that provide potentials for users to support their working tasks and processes. These potentials for action, or affordances, pose a challenge for users to perceive and actualize them. Currently, we have little evidence of the influence factors that most affect affordance perception on an individual level. We developed a model that conceptualizes affordance perception and actualization and derives influence factors for affordance perception from social cognitive theory. We report the results of a survey within an organization, in which we apply this model, and we find that personal capabilities and environmental factors stimulate different affordance perception mechanisms. Additionally, we show the strong link between affordance perception and actualization under malleable technology. Our study contributes to affordance actualization research by explaining differences between users in affordance perception based on varying personal and environmental influence factors and by emphasizing the important role of affordance perception for affordance actualization.

Keywords: Affordance Actualization, Affordance Perception, Malleable IT, Social Cognitive Theory

1 Introduction

Malleable information technology (IT) has become more and more prevalent in organizations. IT such as collaboration platforms (Lehrig et al. 2017) or mobile computer devices (DesAutels 2011) are similar in that they provide relatively generic features. Users can apply and modify these features on their own to support their work (Kallinikos et al. 2013; Schmitz et al. 2016). Thus, malleable IT provides almost endless potentials. Yet, the challenge lies in how to leverage these potentials since many ITs are underutilized (Jasperson et al. 2005). User engagement with IT becomes a pressing issue in this context since malleable IT at least partly shifts the responsibility to actualize potentials from the IT personnel to the users (Richter and Riemer 2013). For instance, quality managers (*users*) want to spread defined business processes throughout the organization to improve the process quality. Since custom solutions are not affordable and the IT department has scarce resources, they can either cancel the plan or utilize malleable IT (e.g., an available collaboration platform) to implement the solution on their own with generic features like notifications and document storage. The quality managers need to perceive this potential and actualize it. Otherwise, the malleable IT will remain underutilized. This puts a heavy burden on the users and, in many cases, the quality managers will not perceive this possibility. Current research focuses on the actualized potentials of different ITs (Leidner et al. 2018; Pozzi et al. 2014; Strong et al. 2014) but largely ignores the perception of potentials. For malleable IT, perception is especially important and may provide a key to how organizations can leverage its unused potentials in the post-adoption phase. Thus, we want to investigate in this paper under which conditions users perceive and actualize potentials under malleable IT.

The existing literature on affordances and, in particular, affordance actualization provides the foundation for our research. Affordances are potentials for goal-oriented action that a particular technology offers to a particular user (Volkoff and Strong 2013). These potentials remain hypothetical so long as the users do not actualize them. Users perceive affordances and can then actualize them, which leads to an outcome (Bernhard et al. 2013). The affordance perception event is the moment when a user becomes "aware of the existence of an action possibility" (Bernhard et al. 2013, p. 5). This depends on available information about the affordance that the user can utilize (Bernhard et al. 2013). Affordance actualization describes the actions taken by a user to realize potentials (Strong et al. 2014). Users need to invest an effort to actualize an affordance (Bernhard et al. 2013), which may prevent an actualization. An affordance actualization represents a behavioral change for users since they need to incorporate the technology into their working tasks. Social cognitive theory (SCT) is based on the idea that behavioral changes are influenced by personal and environmental factors (Bandura 1986). Thus, we suggest integrating SCT into affordance actualization theory and using it to explain differences between users in their affordance actualization behavior.

Existing research on affordance actualization provides valuable insights in affordance actualizations under different IT. However, we identified three gaps that limit our understanding of affordance actualizations under malleable IT as well as the research of affordance actualization for IS in general. First, despite the theoretical acceptance that an affordance actualization requires affordance perception (e.g., Anderson and Robey 2017; Bernhard et al. 2013; Pozzi et al. 2014), current research has focused primarily on affordance actualization and its outcomes (e.g., Leidner et al. 2018; Strong et al. 2014). Additionally, the link between affordance perception and actualization remains unclear (Bernhard et al. 2013). For malleable IT, affordance perception is of high importance, since the potentials of generic features need to be perceived by users themselves (Richter and Riemer 2013). Therefore, we want to test this link to provide evidence for the strong relationship between affordance perception and actualization under malleable IT. This may help us explain different patterns in affordance actualizations between users. Second, existing research has provided many studies about affordance actualizations related to IT (e.g., Anderson and Robey 2017; Leidner et al. 2018; Leonardi 2011; Leonardi 2013; Strong et al. 2014; Thapa and Sein 2017). These studies generate invaluable insights into the dynamics of affordance actualizations. However, these studies do not discuss how individual users perceive affordances of a technology. One exception is the study of Lehrig et al. (2017), which suggests that affordance perception manifests in different mechanisms. Affordance research would benefit from a conceptualization of affordance perception that incorporates different possibilities for perception. This would help to explain differences between users in their affordance perception. Third, although much research has analyzed the outcomes of affordance actualization (e.g., Leidner et al. 2018), the antecedents of affordance perception and actualization remain unclear. Existing research identifies personal abilities and environmental factors in combination with IT as possible influence factors for these constructs (e.g., Goh et al. 2011; Strong et al. 2014). Research would benefit from the separated analysis of influence factors for affordance perception and affordance actualization. In this study, we focus on influence factors for affordance perception as a first step. By targeting these gaps, we not only contribute to the theoretical discourse about affordance actualization but also provide practical implications. The results can provide important guidance for organizations on how to support the post-adoption phase of malleable IT to ensure an enhanced usage of the technology through affordance actualizations.

This study aims to answer the following research question: *How do determinants based on social cognitive theory influence affordance perception of individual users under malleable IT?* We derived three tasks to answer this question and to address the previously mentioned gaps. First, we acknowledge the variety of affordance perception mechanisms (Lehrig et al. 2017). Therefore, we need to conceptualize these different mechanisms to analyze influence factors. We build on the work of Lehrig et al. (2017) and extend their work by incorporating SCT to account for different information sources. Second, we derive influence factors for the different affordance perception mechanisms based on our conceptualization. Third, we propose and test a research model for affordance perception and actualization based on the created conceptualization and the derived influence factors. We tested this model with an online survey among users of an organization that had implemented Microsoft SharePoint (SP) (i.e., a malleable IT). Our results show the strong relationship between affordance perception and actualization under malleable IT and provide first evidence of possible influence factors for affordance perception (i.e., self-efficacy, other users' use and deliberate initiatives). Our key contribution is a conceptualization of the affordance perception and actualization that helps to explain the occurrence of different affordance perception mechanisms and the strong link between affordance perception and actualization.

We organized this paper as follows: In the next chapter, we introduce the theoretical foundations of affordance and SCT. After that, we present the conceptualization of affordance perception and the hypotheses of our research model. This is followed by the methodological description of our work, including the research design, the measures description, and details about the conducted survey. Finally, we present the results of our study and discuss the contributions of our work.

2 Theoretical Foundation

The theoretical foundations of this work are affordance theory and SCT. We apply affordance theory to describe how users actualize potentials under malleable IT, which involves the cognition of potentials. We apply SCT to structure distinct cognition mechanisms and to derive possible influence factors. Therefore, we present the foundations of both theories in this chapter.

2.1 Affordance Theory

Affordance theory has gained recent interest in IS research (e.g., Burton-Jones and Volkoff 2017; Goh et al. 2011; Leidner et al. 2018; Leonardi 2013; Majchrzak et al. 2013; Strong et al. 2014). Affordances describe the action potential offered to someone or something by an object (Volkoff and Strong 2013). The affordance concept originates from the field of ecological psychology, where Gibson introduced the concept based on his observation of animals and their interactions with their environments (Gibson 1979). When Norman applied the affordance concept in his studies about human machine interaction (Norman 1999), the concept also started to spread in IT-related research and later in IS research (Markus and Silver 2008). In this study, we use the relational affordance lens (Hutchby 2001), which defines affordances as a ”relationship between a technical object and a specified user that identifies what the user might be able to do with the object, given the user's capabilities and goals” (Markus and Silver 2008, p. 622). For example, a user may want to collect meeting tasks (*goal*), and a collaboration platform affords the user the creation of a task list (*technical object*) that the user can apply for this purpose. Therefore, affordances exist in the relationship between a user and technical objects (i.e., features of the malleable IT in our study). Different users can use the same feature (or combination of features) to achieve different goals under malleable IT. The pure existence of affordances is insufficient to have an impact. Users need to actualize affordances under malleable IT (Strong et al. 2014).

The general framework of affordances consists of four building blocks: affordance existence, affordance perception, affordance actualization and effect (Bernhard et al. 2013). The first building block, *affordance existence*, defines the hypothetical option space of affordances given specific users and specific technical objects. For malleable IT, this option space is not measurable since the number of possibilities is almost endless. Thus, we omit the further discussion of affordance existence in this study. The second building block, *affordance perception*, describes the event when a user becomes aware of an action possibility (Bernhard et al. 2013). The third building block, *affordance actualization*, describes “the actions taken by actors as they take advantage of one or more affordances through their use of the technology to achieve immediate concrete outcomes in support of organizational goals” (Strong et al. 2014, p. 70). The last building block, *effect*, captures the results of affordance actualization on an organizational level (Leidner et al. 2018; Strong et al. 2014). Since our focus is on the user level in this study, we leave out further explanation and discussions of this block. Thus, we focus on affordance perception and affordance actualization and provide further details of these blocks in the following sections.

Affordance perception describes the event when a user becomes aware of an action potential provided through a technology (Bernhard et al. 2013). After the perception event, the user has at least a vague understanding that he or she can use the technology to achieve a specific goal. The user needs information to create this understanding (Bernhard et al. 2013), and the user can receive this information through two main channels: symbolic expressions of the artifact (i.e., messages communicated by an artifact to a user) (Markus and Silver 2008) or external information (i.e., information from other actors) (Bernhard et al. 2013). For example, a user may realize that she can configure the malleable IT to support and standardize the coordination of machine orders. She perceives this affordance through the advice of a consultant, who explains this possibility to her. There are different options for how this information may reach the user (Lehrig et al. 2017). We will detail these options in our conceptualization of affordance perception in the next chapter.

Affordance perception is a precondition for *affordance actualization*. To actualize an affordance, users must invest effort (Bernhard et al. 2013). For example, the user that has previously perceived the potential to store team documents in the malleable IT can actualize this affordance by storing the documents (*use of the technology*) and communicating this use to his or her team members. Different efforts may be involved in the actualization of an affordance. In the given example, the user must store the documents (*use and possible technology adaptation efforts*) and communicate the usage (*coordination efforts*). Efforts influence whether an affordance is actualized or not. They depend on different factors like the technology, the capabilities of the user and work environment characteristics (Strong et al. 2014).

Existing research focuses on actualization and induced effects and shows comparatively less interest in affordance perception (Pozzi et al. 2014). Most of the recent research tries to identify salient affordances of specific technologies and analyze their actualization (e.g., Burton-Jones and Volkoff 2017; Leidner et al. 2018; Strong et al. 2014). This is a valuable step in understanding affordances of technologies and how they are actualized. However, this leads to a small number of specific affordances. For malleable IT, it would be problematic to assume a given, fixed set of affordances because users must perceive many of the affordances on their own. Therefore, we need an unrestricted view on affordances and their perception in this study.

2.2 Social Cognitive Theory

SCT is based on the idea that individuals change their behavior through an interplay of environmental influences and personal factors (Bandura 1986). These three factors reciprocally influence each other. SCT originates from social psychology and is derived from social learning theory, which states that behaviors develop through observation and imitation of others (Bandura 1977). Thus, humans vicariously learn from others. SCT postulates that individuals take a more active role in this learning process and that the observed consequences of a behavior also have an effect, since they influence the outcome expectation of the behavior (Bandura 1986).

Although SCT was developed in the field of social psychology, it has been applied in many different areas, such as health (Rosenstock et al. 1988), organizational management (Wood and Bandura 1989) and IS research (e.g., Compeau and Higgins 1995a; Compeau et al. 1999). In IS research, SCT was applied to explain how individuals change their behavior regarding technologies (e.g., how training affects computer skills) (Compeau and Higgins 1995a). Even more widespread is the application of self-efficacy in IS research (e.g., Agarwal and Karahanna 2000; Benlian 2015; Jasperson et al. 2005; Schmitz et al. 2016). Self-efficacy is closely related to SCT and focuses on the personal factor aspect of the theory (Wood and Bandura 1989). Self-efficacy is defined as one’s belief of being able to execute a task successfully (Bandura 1977). For example, Benlian (2015) showed that users with higher application-specific self-efficacy engaged in higher initial feature use. Self-efficacy is always related to a task; for example, the same user may have a high self-efficacy to generate analyzes from a predefined report but may also have a low self-efficacy to adapt the calculations in the report. Thus, it is important to define the task related to self-efficacy. Although environmental factors are not explicated in the current research, a number of studies stress the importance of the environment (Compeau et al. 1999).

The actualization of affordances implies a change in behavior. Users must perceive (i.e., learn about) an affordance and then put it into action (i.e., actualize it). Therefore, the integration of SCT can help us explain how affordance perception, in particular, takes place and varies between users. We suggest that different personal factors and variations of the environment lead to different affordance perception events and in turn to variance in the number of perceived affordances on the user level. For example, one user may observe how other users in his or her environment create new artifacts based on malleable IT. Based on SCT, this user is more likely to perceive more affordances for the malleable IT than a second user who has no active users of the malleable IT in his or her environment. This also includes that affordance perception may unfold differently, for example, through external information or symbolic expressions. SCT can help us explain why users may perceive affordances only through external information whereas others perceive affordances through symbolic expressions and external information based on their environment and personal factors. We next present our research model, including a conceptualization of affordance perception, which accounts for these different mechanisms based on SCT.

3 Research Model

Our research model is based on the affordance framework with a focus on affordance perception and actualization. We adapt the definition for affordance perception and actualization for the research model since we are interested in the amount of perception and actualization and not in the events. Thus, for the research model, we define *affordance perception* as the number of action potentials a user perceives for a malleable IT and *affordance actualization* as the amount of goal-oriented use a user realizes with a malleable IT. This chapter is further structured as follows. We first introduce a conceptualization of affordance perception, in which we integrate SCT to explain different perception mechanisms. Afterward, we present our hypotheses for the model utilizing the created conceptualization.

3.1 Conceptualization of Affordance Perception

Affordance perception is put into effect in different ways (Lehrig et al. 2017). We want to capture how single users perceive affordances through different mechanisms. We apply SCT to structure different possibilities to perceive affordances in two categories based on personal factors and environmental influences: autonomous affordance perception (AAP) and heteronomous affordance perception (HAP). Although SCT implies a reciprocal relationship between these two factors (i.e., personal factors influence the environment and the environment influences personal factors), this does not imply that the different factors are of equal strength in all instances (Wood and Bandura 1989). Thus, we define that AAP mechanisms are primarily influenced by personal factors whereas HAP mechanisms are primarily influenced by environmental factors. These two categories can help us explain the occurrence of different affordance perception mechanisms on the user level. They are also in line with existing affordance research, which identifies environmental and personal influence factors as being important for affordance actualization (Bernhard et al. 2013; Strong et al. 2014). Yet, the two categories are difficult to operationalize in a survey. Therefore, we searched for distinctions of affordance perception mechanisms in literature, which are easier for users to grasp and can be attributed to these two categories.

We built on one study that describes affordance perception on a more granular level (Lehrig et al. 2017). The authors describe three affordance perception mechanisms for a collaboration platform (i.e., a malleable IT) (Lehrig et al. 2017): exploring, transferring and imitating. Exploring describes the perception of affordances through symbolic expressions. Transferring describes the perception through knowledge of the user himself applied to a new use case. For imitating, users perceive affordances through other people's use. Yet, the authors have to restrict their findings to a set-up with scarce IT department resources and no mandatory use cases among their observed users (Lehrig et al. 2017). In addition, such mandatory use (Venkatesh and Davis 2000) or deliberate initiatives (Sun 2012) may act as an additional trigger, in which users receive external information to use the malleable IT for a certain use case. Such active information can reach users not only by the IT department or their supervisors but also through their advice network (Sykes et al. 2014). For example, a user can tell another user to apply a task list (i.e., a feature in the malleable IT) to track changes in this project. We add this fourth affordance perception mechanism to our conceptualization of affordance perception, which attributes to active external information (i.e., the advice of another user to perceive an affordance). We term this mechanism "being pushed", since the user is pushed into a specific direction to perceive something new.

We can attribute each of these affordance perception mechanisms to one category. Transferring and exploring depend on the capabilities of the user (i.e., relating existing knowledge to a new context or interpreting symbolic expressions). These mechanisms belong to the category AAP. Being pushed and imitating depend on environmental factors, such as active advice or passive observation of other users. These mechanisms belong to the category HAP. Table II-7 summarizes the definitions of the four affordance perception mechanisms and the affordance perception categories. We use this structure for affordance perception in the following definition of the research model.

Construct	Definition
Autonomous Affordance Perception: A user's perception of an action possibility based on his or her personal factors.	
Transferring	Perception to use the technology for a new purpose by applying the user's existing way of using the technology to this purpose.
Exploring	Perception to use the technology for a new purpose by interpreting the symbolic expressions of the technology.
Heteronomous Affordance Perception: A user's perception of an action possibility depending on environmental influence.	
Imitating	Perception to use the technology for a new purpose by learning about another person's use.
Being Pushed	Perception to use the technology for a new purpose by being advised by another person.

Table II-7 Affordance Perception and Category Definitions

3.2 Hypotheses

We present our hypotheses for our model in this section. First, we present the hypotheses for affordance perception based on our conceptualization of affordance perception. Then, we present the hypothesis that links affordance perception and actualization. Figure II-2 summarizes the research model.

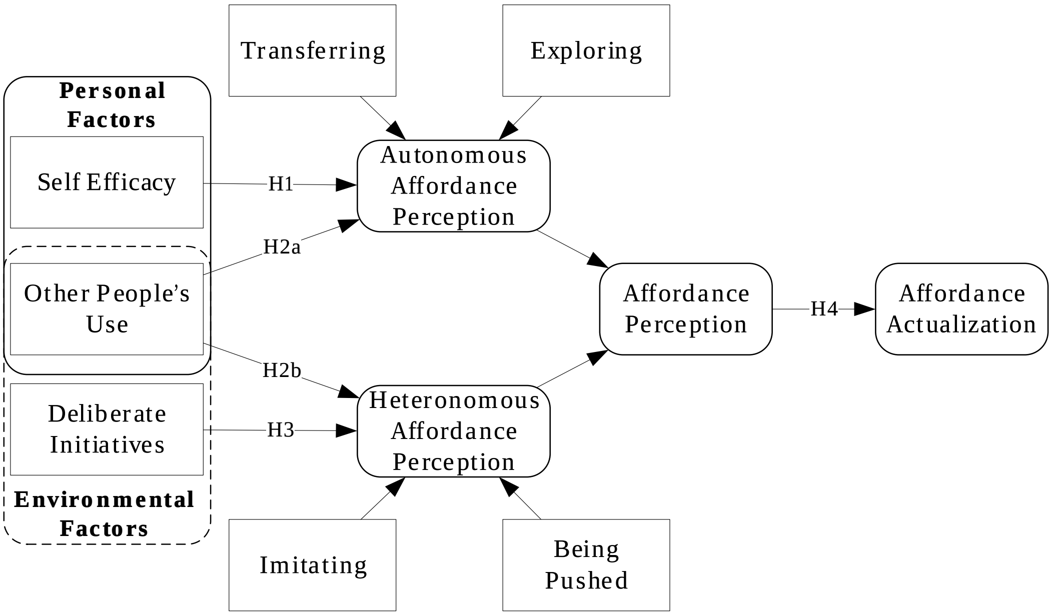


Figure II-2 Research Model

We suggest that personal and environmental factors lead to distinct affordance perception mechanisms as well as autonomous and heteronomous affordance perception. Therefore, we focus on three factors (self-efficacy, other people's use and deliberate initiatives) that derive from SCT and present our hypotheses for these predictors.

Self-efficacy is an established factor for personal capabilities in SCT (e.g., Agarwal and Karahanna 2000; Benlian 2015; Jasperson et al. 2005; Schmitz et al. 2016). We focus on self-efficacy to adapt malleable IT (from here on in short, "self-efficacy"). Users with high self-efficacy have confidence that they can adapt malleable IT to their demands and actualize affordances. SCT suggests that users with high self-efficacy are more likely to invest efforts when confronted with a challenge, whereas users with low self-efficacy avoid risks and reduce their efforts (Bandura 1993). Thus, we argue that users with high self-efficacy are more likely to search for affordances by exploring the system or transferring existing uses to new contexts when they are challenged to support a use case. This makes it more likely that they perceive affordances through autonomous affordance perception. Therefore,

H1: Self-efficacy to actualize affordances is positively associated with autonomous affordance perception.

SCT suggests that people primarily learn through observation of other people's behaviors (Bandura 1986). In IS literature, the idea of learning from others has been used in different studies (e.g., Compeau and Higgins 1995b; Ryu et al. 2005; Sun 2012). Also, in the feature use literature, the influence of other users has been presented. For example, Sykes et al. show the influence of advice networks on emergent use of technologies (Sykes et al. 2014). Users can perceive new ideas on how to use the technology for a new use case, when they observe how other users apply the technology. For example, a user observes how another user adapts the malleable technology to organize guidelines. He can use this observation and organize documents (*imitating*). Thus, other people's use should have a positive effect on heteronomous affordance perception. Although other users are part of the environment, their actions, in this case their use of the malleable IT in different ways, can affect personal factors of the user (Bandura 1986; Bandura 2001). If users become motivated by observing other users successfully using malleable IT (Wood and Bandura 1989), they may feel more confident to explore malleable IT for new usage scenarios. This differs from self-efficacy since the user does not gain any knowledge about adaptation but simply an overall interest in the possibilities of the malleable IT. Thus, we argue that other people's use influences both affordance perception categories. Therefore,

H2a: Other people's use is positively associated with autonomous affordance perceptions.

H2b: Other people's use is positively associated with heteronomous affordance perceptions.

The environmental impact can have a direct influence on affordance perception. Other users, such as supervisors, can request that users utilize a new technology or suggest that they use it for a specific purpose. In the literature, Sun used the term deliberate initiatives (i.e., initiatives taken in response to an external request for attention or an explicit order to use a technology) to describe similar situations (Sun 2012). This direct external information can lead to affordance perception. For example, a user can suggest to another user that they use a malleable IT to standardize input forms for an internal order process. Here, the user does not perceive the affordance on his own but others actively influence him with their opinions or ideas (*being pushed*). Thus, we suggest that deliberate initiatives are an antecedent of heteronomous affordance perception. Therefore,

H3: Deliberate initiatives are positively associated with heteronomous affordance perceptions.

Prior research suggests that affordance perception is an important step for affordance actualization (Bernhard et al. 2013; Leonardi 2013). However, the link between perception and actualization has not been made in IS literature (Bernhard et al. 2013), and the necessity of the perception event is even questioned (Pozzi et al. 2014). In the context of malleable IT, perception becomes even more important since affordances may not be salient, as they are in other applications (Burton-Jones and Volkoff 2017). Therefore, users must realize that they can use malleable IT for specific tasks. For example, a user from the project management office may realize that he or she could use lists and business intelligence functionalities (i.e., features of a malleable IT) to support project reporting. If users perceive more affordances, it is more likely that they also actualize at least some of these affordances to leverage potentials. Therefore,

H4: Affordance perception is positively associated with affordance actualization under malleable IT.

4 Research Methodology

We used a survey to test our hypotheses. In this chapter, we present the development and administration of the survey. First, we present the instrument development process including the selection and development of measures. Second, we provide details about the study setting and the data collection process.

4.1 Measures

We list all measures in Appendix II-A. When possible, we relied on established measures from the literature to ensure reliability. This applies for all independent variables in our model. Thus, measures for self-efficacy (Kankanhalli et al. 2005), other people's use (Sun 2012) and deliberate initiatives (Sun 2012) were directly applied, adapted or extended from existing literature. Since no measures for affordance perception and actualization existed, we had to develop these measures systematically (see "Appendix II-A.1 Scale Development Process"). The development process included a synopsis of existing use and affordance literature, a previous longitudinal study to identify the affordance perception mechanisms (Lehrig et al. 2017), and a pretest of the survey among students and a subsample of users at Alpha. We followed the suggestions from MacKenzie et al. (2011) to ensure the rigorous definition and creation of constructs.

We modeled affordance perception as a composite-formative construct (Bollen 2011; Sarstedt et al. 2016) to capture the different facets of affordance perception based on SCT (see Figure II-3). The construct is a third-order construct consisting at the first stage of four reflective constructs (i.e., the four affordance perception mechanisms). We aggregate the four constructs into two second-order composite-formative constructs: autonomous and heteronomous affordance perception. This enables us to test for the different antecedents of these two categories. The third-order composite-formative construct (i.e., affordance perception) captures affordance perception as a whole and is used as an indicator for affordance actualization. We modeled all other constructs as first-order reflective constructs.

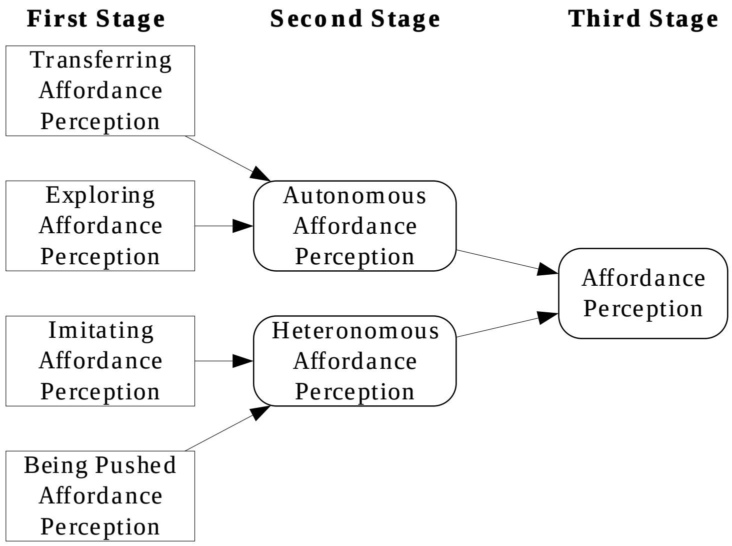


Figure II-3 Third-order Formative Construct: Affordance Perception

We included controls to test the influence of demographic (i.e., education, gender, age) as well as professional characteristics (i.e., tenure, use of SP in previous organizations, usage experience with SP). All of these factors are modeled as single items. Additionally, we added personal innovativeness in IT (PIIT) (Agarwal and Prasad 1998) for affordance perception and actualization as a control, which was applied as an independent or moderating factor in similar studies (e.g., Schmitz et al. 2016; Sun 2012). Furthermore, we controlled for the influence of the ease of support (Venkatesh et al. 2003), technical knowledge team (Nambisan et al. 1999), and sense of power (Anderson et al. 2012) to attribute for differences in actualization efforts. All of these controls were modeled as reflective constructs with at least three items and were taken from existing literature.

4.2 Study Setting and Data Collection

Our target population consisted of users in an organizational context that can actualize potentials with a malleable IT. We surveyed users that used SP (i.e., a malleable IT) to collaborate in an organization Alpha. Alpha was a medium-sized mechanical engineering organization that had implemented SP as an enterprise-spanning collaboration platform. The organization's main locations were in Switzerland and Germany but it also had factories in China, the U.S. and the Czech Republic.

Alpha had initially implemented SP three years before we executed the survey. The organization hosted SP but allowed users to create and configure their own environments so-called "sites". Thus, users could create and configure several sites based on the provided features and could support different use cases with these sites. This allowed them to actualize potentials on their own. The rollout of SP consisted of a pilot phase, in which dedicated users were invited to use SP for their work. Afterward, Alpha allowed all users to use SP. However, only limited support for the creation and configuration of sites was available due to scarce resources in the IT department. Thus, the users often had to perceive and actualize the potentials on their own.

We selected Alpha and SP for several reasons. First, we had conducted a longitudinal study regarding SP in the organization before and had in-depth information about the environment and direct access to the SP system for validations. Second, using an organizational context allowed us to test our hypotheses in a real-world scenario and to identify practical implications. Third, SP is a malleable technology that is used in different contexts, such as collaboration platforms, knowledge management or process applications. Similar applications like Lotus Notes or other collaboration platforms have been used in previous studies to analyze micro-level changes and innovative use through IT in organizations (e.g., Maruping and Magni 2015; Orlikowski 1996). Therefore, we perceive SP as an appropriate technology to analyze affordance perception and actualization in organizations.

We hosted the survey in an online survey tool and provided the survey in German and English to account for the different locations of Alpha. Users could choose between the two languages based on personal preferences. We created the original survey in English. Two university members independently translated the questions to German, compared their results, and created a consistent version. A third university member checked the results for consistency and accuracy.

The participants included all users of SP based on the permissions provided by the production system (739 total users). We distributed the survey via email to all users in January 2018. The email contained information about the survey and a link to conduct the survey. A reminder email was sent two weeks after the initial invitation. We received complete surveys from 167 users. We deleted thirteen of these surveys either because the execution time was below six minutes (the average execution time was 20 minutes) or the answers showed no variance (e.g., only 1s or 7s). This left us with 154 responses (response rate: 20.8%). Table II-8 displays the demographic information of the sample. The high rate of men is noteworthy in this sample. We tested the sample for non-response bias based on the demographic characteristics (see "Appendix II-C.6.1 Non-Response Bias Test"). The tests showed that non-response was not an issue in this study.

Variables	Sample Composition		Variables	Sample Composition	
Age	< 25 years	0.6 %	Tenure	0 to 2 years	6.5 %
	25 to 29 years	5.2 %		3 to 5 years	23.4 %
	30 to 34 years	13.0 %		6 to 10 years	13.0 %
	35 to 39 years	16.9 %		Over 10 years	57.1 %
	40 to 44 years	14.3 %	Education	High school degree	8.4 %
	45 to 49 years	12.3 %		Matura/Abitur	3.9 %
	Over 49 years	37.7 %		Professional degree	20.1
Gender	Female	9.1 %		Bachelor’s degree	26.0 %
	Male	90.9 %		Master’s degree	39.0 %
				Doctorate degree	2.6 %

Table II-8 Demographic Characteristics of Sample

5 Data Validation and Analysis

5.1 Measurement Model

We used the partial least square (PLS) structural equation method (SEM) to conduct our data analysis. We chose PLS for multiple reasons over covariance-based SEM. First, our research is exploratory since no measures for affordance perception exist (Hair et al. 2011). Second, PLS has advantages in handling hierarchical (Wetzels et al. 2009) and formative constructs (Hair et al. 2011; Petter et al. 2007), such as the affordance perception construct in our model. Recent literature especially advises the use of PLS over covariance-based SEM for composite-formative indicators (Sarstedt et al. 2016). Third, our structural model is complex (Hair et al. 2011), which also excluded ordinary least squares regression.

We conducted several tests to ensure the fit, validity, and reliability of our model. There is controversy about appropriate model fit measures for PLS-SEM, especially for models containing composite-formative constructs in current research (Henseler et al. 2016). Thus, we assessed the model fit of our model with different indicators (SRMR, NFI, d_{G1}, d_{G2} and d_{ULS}) to generate a diversified picture of model fit (see "Append II-B.1 Model Fit"). The results suggest that we established a good model fit, which built the foundation for our further tests. We tested the model for convergent and discriminant validity as well as reliability for all reflective variables. For discriminant validity, we verified that the average variance extracted (AVE) for all reflective variables is greater than .50 (Fornell and Larcker 1981). For discriminant validity, we conducted three tests for the reflective variables: Fornell and Larcker criterion (Fornell and Larcker 1981), significant loadings of latent variables with measurement items (Gefen and Straub 2005), and heterotrait-monotrait (HTMT) ratio (Henseler et al. 2015). The results of all tests allow us to suggest that the discriminant validity is established for the reflective variables. The reliability of reflective variables was tested with three indicators: Cronbach's Alpha (Cronbach 1951), construct reliability (Fornell and Larcker 1981), and ρ_α (Dijkstra and Henseler 2015b). All indicators show values above the threshold of .70 and confirm reliability. We describe test details and show the values in "Appendix II-B.2.1 Reflective Variable: Validity and Reliability Tests". For formative variables, we assessed validity by calculating the significance of weights and loadings (see Table II-9) (Hair et al. 2011) as well as the adequacy coefficient R_a^2 (Edwards 2001). Both tests support the validity of the formative constructs (see "Appendix II-B.2.2 Formative Variable: Validity and Reliability Tests"). Reliability is not an issue of formative variables (Edwards 2001; MacKenzie et al. 2011). Thus, we conducted no tests for reliability but ensured a proper development of the variables (see "Appendix II-A.1 Scale Development Process").

In addition to validity and reliability, we also tested for multicollinearity (see "Appendix II-C.3 Multicollinearity Analysis") and vanishing tetrads (see "Appendix II-C.2 Vanishing Tetrads Analysis") in our measurement model. The result of these two analyzes led to the removal of item "AA4" since the vanishing tetrads test showed issues with this item (Bollen and Ting 2000). After the removal, both analyzes confirmed our model. Thus, we assume that multicollinearity is not an issue in this model and that we specified all variables correctly.

Main Construct	Sub-Construct	Weight	t-value	p-value	VIF
Autonomous AP	Exploring AP	.370	5.497	< .001	2.829
Autonomous AP	Transferring AP	.678	10.767	< .001	2.829
Heteronomous AP	Being Pushed AP	.457	7.197	< .001	1.744
Heteronomous AP	Imitating AP	.639	10.476	< .001	1.744
AP	Autonomous AP	.548	4.507	< .001	2.172
AP	Heteronomous AP	.526	4.271	< .001	2.172

PLS algorithm, weighting-scheme: path, bootstrapping samples: 1000, latent factors used in model.

Table II-9 Formative Construct Weights

Since we obtained the data for independent and dependent variables from the same person, we had to test for common method bias issues (Podsakoff et al. 2003). We executed two tests: Harman's single factor test (Podsakoff et al. 2003) and a full collinearity analysis for all dependent latent factors (Kock 2015). Both tests suggested that common method bias is not an issue in this study (see "Appendix II-C.6.2 Common Method Bias Test").

5.2 Structural Model

We present the most important results of the structural model in this section. We provide details about the data analysis including model descriptions and setups for the tests in Appendix II-C. The results of our analysis are shown in Table II-10 and a summary of our hypotheses is shown in Table II-11.

We modeled affordance perception as a third-order variable. We used a two- (and three)-stage approach to calculate these higher-order variables because our primary interest was in the second and third-order variables (Becker et al. 2012). For this approach, we calculated the latent variable scores of the four first-order indicators (affordance perception mechanisms) and utilized them to calculate the second-order formative constructs. After that, we used the second-stage model to calculate the latent variable scores for the second-order constructs and used them in a new model to display the third-order construct. Table II-9 summarizes the relationships in the third-order construct. These results show that all mechanisms are significant and contribute to affordance perception. The variation within the weights (between .370 (exploring)

Variables	AAP		HAP		AP	AA	
Predictors	**β**	**f^2**	**β**	**f^2**	**β**	**β**	**f^2**
Self-Efficacy **(H1)**	.30*** (.08)	.13					
Other People's Use **(H2a, H2b)**	.38*** (.06)	.25	.35*** (.09)	.18			
Deliberate Initiatives **(H3)**			.40*** (.09)	.23			
AAP					.55*** (.13)		
HAP					.53*** (.13)		
AP **(H4)**						.65*** (.07)	.82
Controls	**β**	**f^2**	**β**	**f^2**	**β**	**β**	**f^2**
Age	-.05 (.07)	.00	.13 (.08)	.02		.08 (.05)	.01
Gender	.00 (.04)	.00	-.05 (.04)	.00		.12* (.06)	.03
Experience	.20** (.07)	.07	.13* (.06)	.03		.02 (.06)	.00
Tenure	-.01 (.07)	.00	-.07 (.08)	.01		.04 (.06)	.00
Education	.00 (.05)	.00	.00 (.06)	.00		-.18*** (.05)	.07
PIIT	.11 (.06)	.02	.03 (.06)	.00		.01 (.06)	.00
Other Organization	.10 (.09)	.02	.09 (.06)	.01		-.08 (.09)	.02
Sense of Power						.11* (.05)	.03
Ease of Support						.12* (.06)	.03
Technical Knowledge Team						.07 (.06)	.01
R^2	**.53*** (.06)**		**.52*** (.05)**		**.58*** (.05)**	**.63*** (.05)**	
R^2 adjusted	**.50*** (.06)**		**.49*** (.06)**		**.55*** (.05)**	**.60*** (.05)**	

Notes: 1. *** = p < .001; ** = p < .01; * = p < .05

2. Standard errors reported in parentheses.

3. Model set-up for calculations: Algorithm: PLS algorithm, weighting-scheme: path, bootstrapping samples: 1000.

4. R^2 for affordance perception calculated in separated model (3rd level) because of formative nature.

5. Controls:

a. We controlled for age, gender, experience, tenure, education, personal innovativeness in IT, and other organization use on affordance perception level.

b. We controlled additionally for sense of power, ease of support and technical knowledge team on affordance actualization level.

Table II-10 Structural Model Results

and .678 (transferring)) indicate their relative importance for the construct (Cenfetelli and Bassellier 2009).

The results support our hypotheses for the antecedents of different affordance perception categories. Table II-10 presents the results of the structural model. Self-efficacy has a significant effect on autonomous affordance perception (β = .299, p-value < .001, f^2 = .132), which supports Hypotheses H1. Deliberate initiatives have a significant effect on heteronomous affordance perception (β = .397, p-value < .001, f^2 = .232), which supports Hypotheses H3. Both affordance perception categories are significantly correlated to other people use. Thus, Hypotheses H2a and H2b are also supported. Experience is the only control that has a significant effect ($p < .05$) on both affordance categories (AAP: β = .203, p-value = .003, f^2 = .067; EAP: β = .132, p-value = .038, f^2 = .030). These results are also confirmed regarding the f^2 values. Here, self-efficacy, deliberate initiatives and other people's use have (an almost) medium effect (f^2 > .15 (Chin 1998)) on the affordance perception categories. The results also show that the three factors and the controls explain 52.6% (autonomous) and 52.3% (heteronomous) percent of the variance (R^2), which indicates a moderate (.333) to substantial (.670) share (Chin 1998).

Hypothesis	Results	β	p-value	f^2
H1: SE $\xrightarrow{+}$ AAP	Supported	.299	< .001	.132
H2a: OPU $\xrightarrow{+}$ AAP	Supported	.384	< .001	.251
H2b: OPU $\xrightarrow{+}$ HAP	Supported	.349	< .001	.180
H3: DI $\xrightarrow{+}$ HAP	Supported	.397	< .001	.232
H4: AP $\xrightarrow{+}$ AA	Supported	.654	< .001	.815

Table II-11 Summary Results

Affordance perception has a strong and significant effect on affordance actualization (β = .654, p-value < .001, f^2 = .815), which supports Hypotheses H4. Overall, the model explains 63% of the variance for affordance actualization, which is considered almost substantial (Chin 1998). Besides affordance perception, the following controls had a significant effect on affordance perception: education (β = -.180, p < .001, f^2 = .078), gender (β = .114, p = .039, f^2 = .033), sense of power (β = .129, p = .008, f^2 = .039), and ease of support (β = .129, p = .033, f^2 = .036).

6 Discussion

This paper investigates how users perceive and actualize affordances under malleable IT. We build on previous research on affordance actualization and integrate SCT to propose a research model to validate the antecedent for affordance perceptions of users under malleable IT. For this purpose, we developed a conceptualization of affordance perception that incorporates SCT to categorize different affordance perception mechanisms. We conducted an empirical study in an organization that has implemented a malleable IT, to test our hypotheses. The results show that different conditions (i.e., other people's use, deliberate initiatives and self-efficacy) explain variances of affordance perception on the individual level. We also could confirm the close relationship between affordance perception and actualization in our model.

6.1 Contributions

Our research contributes to the field of affordance actualization by (1) providing evidence that affordance perception is an important prerequisite for affordance actualization, (2) conceptualizing affordance perception as a formative construct based on SCT and (3) identifying antecedents of affordance perception under malleable IT.

Our first contribution is evidence that affordance perception is an important part of the affordance framework under malleable IT. The existing literature on affordances focuses on IT, which organizations implement to achieve specific outcomes, such as electronic health records (Strong et al. 2014) or enterprise social platforms (Leidner et al. 2018). This research identifies specific affordances for these IT, how they are actualized, and the concrete outcome of their actualization on an organizational level (Volkoff and Strong 2013). However, most of the research remains silent about the affordance perception phase (Pozzi et al. 2014) since the identified affordances are predominant and their perception secondary. In our opinion, affordance perception is the key in actualizing affordances under malleable IT as users have the possibility to actualize the affordance on their own and are not dependent on global affordances (Richter and Riemer 2013). Therefore, we analyzed the link between affordance perception and actualization in our model. We found a strong positive relationship between affordance perception and affordance actualization but also showed that both constructs are distinct (i.e., discriminant validity). These findings provide arguments to extend the research of affordance actualization by incorporating affordance perception in future research. This can also enhance our understanding of why users may not actualize perceived affordances.

Our second contribution is the conceptualization of affordance perception as a formative construct based on SCT. The existing research on affordance actualization has brought us deep insights into affordance actualizations and their impact on the organizational level context (e.g., Leidner et al. 2018; Strong et al. 2014). However, this research does not explain why the actualization of affordances varies between users. We showed in our study the strong relationship between affordance perception and actualization under malleable IT (first contribution). This may be the key to explaining the variation of affordance actualization. Nevertheless, we needed a conceptualization of affordance perception that accounts for different perception possibilities. Therefore, we conceptualized affordance perception based on SCT as a formative construct consisting of distinct perception mechanisms (Lehrig et al. 2017) that reflect the possibilities of users to perceive affordances. The different possibilities to perceive affordances led to variance in the overall perception of affordances and in turn to variances in affordance actualizations. Our conceptualization based on SCT accounts for different possibilities to perceive affordances that culminate in an overall affordance perception. Although the importance of single mechanism (e.g., exploring) may vary, all mechanisms contribute to the overall affordance perception and in turn, to affordance actualization.

Our third contribution is the validation of influence factors for affordance perception for individual users under malleable IT. Existing research suggests different influence factors for affordance actualizations, such as users' capabilities and the work environment (Strong et al. 2014). However, the influence factors are theorized for affordance actualization as a whole, and it remains unclear how and whether they influence affordance perception. Therefore, we tested in our study the influence of self-efficacy, other people's use, and deliberate initiatives on affordance perception. We selected these influence factors from existing research based on SCT and theorized their influence on different affordance perception mechanisms. Our findings show that these influence factors affect different affordance perception mechanisms under malleable IT. The three determinants explain a substantial amount of the variance of affordance perception. These results confirm the strong influence of social cognitive factors on perception under malleable IT. Most noteworthy is the role of other people's use on both affordance perception categories, which implies the strong influence of personal networks on affordance perceptions. These findings enhance our understanding of the influence of user capabilities and the environment on affordance actualization.

6.2 Future Research

There are some avenues for future research. This study focused on the affordance perception and its influence on affordance actualization under malleable IT. However, it did not take into consideration the adaptation of malleable IT, which can provide additional insights into the transition from affordance perception to actualization (Lehrig et al. 2017). Adaptation should be incorporated into the model in future studies to better account for the adaptation necessities of malleable IT (Schmitz et al. 2016). In particular, relationships between different kinds of perception mechanisms and adaptation would be of interest to understand the underlying dynamics. Another avenue for future research is the usage of the created constructs for affordance perception and actualization in different studies. The created items should be further validated in new contexts beyond malleable IT. It would be of particular interest whether perception mechanisms vary between technologies or whether other perception possibilities might exist. Research in this area would enhance our understanding of how to support a higher utilization of IT.

6.3 Practical Implications

For praxis, this study provides insights in affordance perception and actualization that can be utilized to foster affordance actualizations under malleable IT in organizations. The study shows the important role of affordance perception for affordance actualization. Thus, organizations should think about how users could perceive new affordances. The identified antecedents (self-efficacy, other people's use, and deliberate initiatives) provide some guidance on how to do this. Other people's use is an especially important factor for affordance perception. Thus, organizations should try to encourage specific users to share their use cases with others and spread ideas. This will foster affordance perceptions and in turn affordance actualizations. In parallel, organizations should also try to enhance self-efficacy to adapt the malleable IT among users. For example, trainings or coaching sessions could provide confidence to key users. Additionally, the organization could also initiate campaigns to identify useful usage scenarios and promote them as deliberate initiatives. Combined efforts will enhance the likelihood of affordance perceptions and leverage the potentials of malleable IT.

6.4 Limitations

Our study also has some limitations. For example, we had to develop new items for the affordance related constructs (i.e., affordance perception and actualization). Although we applied rigorous standards in the development process, these items need refinement to ensure validity and reliability. The created model already provided a high level of complexity (e.g., a third-order formative construct and more than ten multi-item latent variables, including controls). Therefore, we had to select possible antecedents but could not include all of them. For example, existing research suggests that advice networks play an important role in the affordance perception and actualization (Lehrig et al. 2017). We tried to include this interaction with a proxy variable, other people's use, but instead suggest using a more advanced data collection approach, such as the one applied by Sykes et al. (2014). Although we tested for common method bias, we cannot fully exclude this issue. Therefore, conceptualizations for dependent variables are needed that can be measured independently. The literature on effective use may provide suggestions for how to resolve this limitation (Burton-Jones and Straub 2006; Burton-Jones and Volkoff 2017). Finally, our study context (i.e., an entire organization) allowed us a broad test of our theory. However, it also required a high abstraction level regarding questions and working context. A narrower context like a division or a single team would allow for more specific questions and results.

Appendix II-A. Instrument Development[2]

II-A.1 Scale Development Process

There were no instruments available to measure affordance perception and actualization. Therefore, we had to develop these measures for our work. To ensure high quality standard, we followed the steps suggested by MacKenzie et al. (2011) to conceptualize constructs, develop measurements and evaluate scales. The conceptualization of affordance perception and actualization started with a review of the affordance literature and use literature. This phase led to the creation of a definition (see Table II-12) as well as the identification of dimensions for each construct. Based on the multidimensionality of affordance perception, we decided to model affordance perception as formative variable with the sub-dimensions: Being pushed, imitating, transferring and exploring. Afterward, we generated items to represent each new construct. These items and the suggested attributes were then used to assess the content validity by conducting a content adequacy test (Yao et al. 2008). Five students rated the items regarding their fit to different dimensions. Despite the small sample size, the tests confirmed our suggested conceptualizations. Afterward, we conducted a pilot test with all constructs from our suggested measurement model. The pilot test included ten users who worked at Alpha and used the malleable IT. We not only received the conducted surveys of these users but also qualitative feedback regarding the wording of specific items in the context of Alpha. The pilot test lead to a refinement of the items. For example, we removed one item for affordance actualization after we conducted an exploratory factor analysis with the pilot sample and this item deviated strongly from the other items. Further refinement tests were not possible because of limited resources at Alpha and time constraints. Overall, we tried to apply rigorous methods to establish proper conceptualizations and measurements of our newly created items. For existing constructs, we provide definitions and references in Table II-13.

[2] We used the internal name of the application in the original survey. For this paper, we replaced the internal name with the placeholder “malleable IT” in the survey as well as in the definition of constructs.

Construct	Definition
Affordance Actualization	Affordance Actualization describes the amount of goal-oriented use a user realizes with a malleable IT.
Affordance Perception	Affordance perception describes the amount of action potential a user perceives.
Being Pushed	Perception to use the technology for a new purpose by being advised by another person.
Imitating	Perception to use the technology for a new purpose by learning about another person's use.
Transferring	Perception to use the technology for a new purpose by applying the user's existing way of using the technology to this purpose.
Exploring	Perception to use the technology for a new purpose by interpreting the symbolic expressions of the technology.

Table II-12 Construct Definitions for developed Constructs

Existing Constructs from Literature	
Construct	**Definition**
Self-Efficacy Compeau and Higgins (1995b)	Self-Efficacy describes one's belief to adapt "malleable IT" for work tasks.
Other People's Use Sun (2012)	Other people's use describes situations where a user observes an unfamiliar use of the "malleable IT" by another user.
Deliberate Initiatives Sun (2012)	Deliberate initiatives describe initiatives "one takes in response to a request for an increased level of attention, when asked to think, or while being explicitly questioned."
Controls	
Ease of Support Derived from Facilitating Conditions (Thompson et al. 1991)	Ease of support describes the perceived availability of assistance that a user can receive to adapt "malleable IT".
Personal Innovativeness with IT Agarwal and Prasad (1998)	Personal innovativeness with IT describes the willingness of an individual to try out any new IT.
Sense of Power Anderson et al. (2012)	Sense of power describes the perception of a user's ability to influence another person or other people.
Technical Knowledge Team Adapted from Technological Cognizance (Nambisan et al. 1999)	Technical knowledge team describes the perception of a user about the colleagues technical capabilities to use "malleable IT".

Table II-13 Construct Definitions and References for existing Constructs

II-A.2 Reflective First-Order Constructs and Items

Code	Item	Loading	Std Err	p-value	Mean	Std Dev
Affordance Actualization (AA): Self developed; Scale: Likert 1-7 *The following statements refer to changes in team processes, (i.e. in collaboration processes with colleagues), that you put into practice by using the "malleable IT". Since the "malleable IT" has been made available, I …*						
AA1	*… often changed team processes by using the "malleable IT".*	.826	.046	< .001	2.81	1.585
AA2	*… actualized many new team processes with features provided by the "malleable IT".*	.894	.038	< .001	2.81	1.600
AA3	*… established many new ways of collaborating with others by leveraging the "malleable IT".*	.952	.028	< .001	3.18	1.773
AA4[3]	*… opened up many new ways of working together that are supported by the "malleable IT".*	-	-	-	3.17	1.748
AA5	*… effectuated changes in many team processes by introducing the "malleable IT" to support specific use cases.*	.913	.028	< .001	2.83	1.579
Imitating Affordance Perception (IMAP): Self developed; Scale: Likert 1-7 *Since the "malleable IT" has been made available, I often perceived new possibilities of using the "malleable IT", by…*						
IMAP1	*… observing what others did.*	.821	.042	< .001	3.435	1.722
IMAP2	*… learning from other people`s use.*	.872	.030	< .001	3.474	1.677
IMAP3	*… copying from others.*	.895	.042	< .001	2.896	1.646
Transferring Affordance Perception (TRAP): Self developed; Likert 1-7 *Since the "malleable IT" has been made available, I often perceived new possibilities of using the "malleable IT", by…*						
TRAP1	*… transferring my existing use to a new use case.*	.947	.023	< .001	2.935	1.652

[3] AA4 removed because of issues in vanishing tetrads test.

TRAP2	*… reapplying my current use of the "malleable IT" to another use case.*	.905	.030	< .001	2.838	1.682
TRAP3	*… extending existing ways of using the "malleable IT" to a new use case.*	.933	.019	< .001	2.623	1.589
Exploring Affordance Perception (EXAP): Self developed; Scale: Likert 1-7 *Since the "malleable IT" has been made available, I often perceived new possibilities of using the "malleable IT", by…*						
EXAP1	*… experimenting with the features of the "malleable IT".*	.924	.024	< .001	2.747	1.690
EXAP2	*… trying to find new uses of the "malleable IT" on my own.*	.912	.019	< .001	2.721	1.655
EXAP3	*… trying to use the "malleable IT" in novel ways.*	.920	.025	< .001	2.695	1.678
Being Pushed Affordance Perception (BPAP): Self developed; Scale: Likert 1-7 *Since the "malleable IT" has been made available, I often perceived new possibilities of using the "malleable IT", by…*						
BPAP1	*… being pointed by others to new use opportunities.*	.963	.041	< .001	2.818	1.598
BPAP2	*… others suggesting me how I could make use of the "malleable IT" in a particular use case.*	.801	.063	< .001	2.903	1.744
BPAP3	*… others indicating me particular use cases for the "malleable IT".*	.828	.059	< .001	3.143	1.751
Self-Efficacy (SE): Adapted from Kankanhalli et al. (2005); Scale: Likert 1-7						
SE1	*I have confidence in my ability to adapt the "malleable IT".*	.806	.060	< .001	3.318	1.792
SE2	*I have the expertise needed to adapt the "malleable IT".*	.948	.044	< .001	2.818	1.721
SE3	*I am confident to be successful in adapting the "malleable IT".*	.775	.057	< .001	3.494	1.862
Other People's Use (OPU): Adapted from Sun (2012) (External Observation); Scale: Likert 1-7						
OPU1	*I often saw others adapt the "malleable IT".*	.848	.048	< .001	2.416	1.390
OPU2	*I often observed how others modified the "malleable IT".*	.916	.028	< .001	2.37	1.409

OPU3	*I often noticed adaptations of the "malleable IT" by others.*	.978	.036	< .001	2.513	1.406
Deliberate Initiatives (DI): Adapted from Sun (2012) (Deliberate initiatives, third item self developed); Scale: Likert 1-7						
DI1	*Others often asked me to use the "malleable IT" in team processes.*	.871	.052	< .001	2.727	1.522
DI2	*I was often urged by others to use the "malleable IT" for team collaboration.*	.858	.040	< .001	2.877	1.626
DI3	*I was often told to use the "malleable IT" for use cases by others.*	.926	.034	< .001	2.773	1.627

Notes:

1. Test set-up: Model: first stage model; Algorithm: Consistent PLS; weighting-scheme: factor; bootstrapping sample size: 1000; All latent factors connected.
2. All Likert scales from 1 to 7 ranged from Strongly Disagree (1) to Strongly Agree (7)

Table II-14 Reflective First-Order Constructs and Items Values

II-A.3 Higher-Order Formative Constructs

Construct	Level	Sub-constructs	Weight	Loading	p-value	VIF
HAP	Second-order	Being Pushed AP	.370	.875	< .001	1.744
		Imitating AP	.678	.938	< .001	1.744
AAP	Second-order	Exploring AP	.457	.915	< .001	2.829
		Transferring AP	.639	.976	< .001	2.829
Affordance Perception	Third-order	AAP	.548	.934	< .001	2.172
		HAP	.526	.928	< .001	2.172

Test set-up: All values for second-order calculated based on latent factors of first-order with PLS, weighting-scheme: factor; bootstrapping sample size: 1000; all higher-order constructs in mode B.

Table II-15 Higher-Order Formative Constructs Values

II-A.4 Controls

Code	Item	Loading	Std Err	p-value	Mean	Std Dev
Personal Innovativeness with IT (PIIT): Agarwal and Prasad (1998); Scale: Likert 1-7 *Please consider for the following statements your personal attitudes regarding IT in general (not specifically for the "malleable IT").*						
PIIT1	*If I heard about a new information technology, I would look for ways to experiment with it.*	.875	.090	< .001	5.227	1.255

PIIT2	*Among my peers, I am usually the first to try out new information technologies.*	.966	.095	< .001	4.39	1.457
PIIT3	*In general, I am not hesitant to try out new information technologies.*	.767	.091	< .001	5.357	1.261
PIIT4	*I like to experiment with new information technologies.*	.819	.083	< .001	5.247	1.310
Technical Knowledge Team (TKT): Selected and adapted from Nambisan et al. (1999); Scale: Likert 1-7						
TKT 1	*My colleagues understand how to apply the "malleable IT" features.*	.959	.042	< .001	3.435	1.567
TKT 2	*My colleagues know how to use the features of the "malleable IT".*	.944	.040	< .001	3.461	1.522
TKT 3	*My colleagues have the technical capabilities to use the "malleable IT".*	.879	.057	< .001	3.773	1.502
Sense of Power (SoP): Adapted from Anderson et al. (2012); Scale: Likert 1-7 The following statements refer to your relationships with those colleagues with whom you regularly work together.						
SoP1	*I get my colleagues to listen to what I say.*	.735	.115	< .001	4.935	1.375
SoP2	*I get my colleagues to do what I want.*	.963	.090	< .001	4.760	1.343
SoP3	*I think I have a great deal of power.*	.893	.130	< .001	4.597	1.449
SoP4	*If I want to, I get to make the decisions.*	.789	.132	< .001	4.669	1.576
Ease of Support (EoS): Partly Self developed; Question 3: Venkatesh et al. (2003) (Facilitating Conditions); Scale: Likert 1-7						
ESU1	*Getting support to adapt the "malleable IT" is simple.*	.897	.044	< .001	2.766	1.558
ESU2	*It is easy for me to receive help with adaptations of the "malleable IT".*	.937	.040	< .001	2.799	1.536
ESU3	*A specific person is easily available for assistance when I want to adapt the "malleable IT".*	.953	.047	< .001	2.812	1.652

Table II-16 Multi-Item Controls Values

Construct	Item	Range and absolute values	Mean	Std Dev
Age	*Age:*	*(1) < 25 = 1* *(2) 25-29 = 8* *(3) 30-34 = 20* *(4) 35-39 = 26* *(5) 40-44= 22* *(6) 45-49 = 19* *(7) > 49 = 58*	5.266	1.684
Gender	*Gender:*	*(1) Female = 14* *(2) Male = 140*	1.910	0.288
Tenure	*Tenure (at organization Alpha or a unit of the Alpha group):*	*(1) 0 to 2 years = 10* *(2) 3 to 5 years = 36* *(3) 6 to 10 years = 20* *(4) > 10 years = 88*	3.208	1.014
Education	*Please indicate your current highest educational degree:*	*(1) No schooling completed = 0* *(2) High school degree = 13* *(3) Matura/Abitur = 6* *(4) Professional degree = 31* *(5) Bachelor degree = 40* *(6) Master degree = 60* *(7) Doctorate degree = 4*	4.909	1.270
Other Organization	*Did you use "malleable IT" in your previous organization?*	*(1) Yes = 14* (2) *No = 137* *3 participants no answer*	1.838	0.577
"Malleable IT" Experience	*Please indicate how long you have been using "malleable IT" in total (including previous organizations):*	*(1) < 6 months = 29* *(2) 6 months to 1 year = 25* *(3) 1 to 2 years = 61* *(4) 3 to 5 years = 34* *(5) > 5 years = 4* *1 participant no answer*	2.710	1.126

Table II-17 Single Item Control Values

Appendix II-B. Model Fit, Validity and Reliability Tests

II-B.1 Model Fit

For covariance-based-SEM, model fit is an important prerequisite for reliable results (Gefen et al. 2011). Many indicators are available to estimate the model like GFI or RMSEA in CB-SEM (MacKenzie et al. 2011). However, for PLS-SEM this consensus has not been reached, yet (Henseler et al. 2016). Different model fit criteria are available but the thresholds vary and especially for composite models (like in our case) no standard criteria is available. Nevertheless, we used different fit values suggested by current research to evaluate the fit of our models (see “Appendix II-C.1 Data Analysis Set” for information about different models). For all models, we also distinguish between the saturated and the estimated model. Table II-18 shows the results of our tests. First, we calculated SRMR for all three models. The values vary between .035 and .067, which is below the threshold of .08 (Henseler et al. 2015; Hu and Bentler 1999). This is also confirmed by the bootstrapped SRMR values and the calculated confidence intervals[4]. The same holds true for the indicators for discrepancies between empirical and the model-implied correlation matrix (i.e., d_{ULS}, d_{G1} and d_{G2}), which are also within the confidence intervals for the later stage models (Dijkstra and Henseler 2015a). We also calculated the NFI, which is between .747 and .842 below the suggested threshold of .90. However, for composite models this thresholds is not applicable and no adequate values are currently available (Henseler et al. 2016). Therefore, we suggest that the fairly high values indicate an overall good model fit.

	Saturated Model				Estimated Model			
		p-value	Interv. 2.5%	Interv. 97.5%		p-value	Interv. 2.5%	Interv. 97.5%
1st Stage Model (all reflective first-order items)								
SRMR	0.035	< .001	0.028	0.040	*0.067*	< .001	0.033	0.047
d_{ULS}	1.300	< .001	0.806	1.677	*4.603*	< .001	1.141	2.317
d_{G1}	2.970	< .001	2.122	5.281	3.426	< .001	2.217	5.676
d_{G2}	2.111	.001	1.318	3.670	2.496	.001	1.386	4.007
NFI	.778				.747			

[4] Exceptions: For the first and second stage models, the SRMR values are outside the confidence intervals. The reason could be attributed to the incomplete conceptualization of affordance perception in these stages.

2nd Stage Model (reflective first-order items and formative second-order autonomous AP and heteronomous AP)								
SRMR	0.038	< .001	0.026	0.038	*0.049*	< .001	0.030	0.045
d_{ULS}	0.944	< .001	0.436	0.965	*1.614*	< .001	0.612	1.377
d_{G1}	1.708	< .001	1.626	2.884	1.852	< .001	1.623	2.820
d_{G2}	0.876	< .001	0.693	1.199	1.036	< .001	0.713	1.263
NFI	.842				.829			
3rd Stage Model (reflective first-order items and formative third-order AP)								
SRMR	0.043	< .001	0.028	0.048	0.044	< .001	0.031	0.054
d_{ULS}	1.148	.006	0.510	1.478	1.199	.028	0.595	1.812
d_{G1}	1.661	< .001	1.532	2.651	1.650	< .001	1.528	2.671
d_{G2}	0.914	< .001	0.665	1.146	0.914	< .001	0.677	1.193
NFI	.834				.836			

Notes:

1. Test set-up for 1st stage model: Algorithm: Consistent PLS; Bootstrap sample size: 1000; weighting-scheme: factor
2. Test set-up for 2nd and 3rd stage model: Algorithm: PLS; Bootstrap sample size: 1000; weighting-scheme: factor

Table II-18 Model Fit Values

II-B.2 Validity and Reliability Tests

We conducted several tests for convergent and discriminant validity as well as reliability to ensure a high quality of variables. We separate our results presentation into tests for reflective and formative variables since these variables types require distinct validation methods (MacKenzie et al. 2011).

II-B.2.1 Reflective Variable: Validity and Reliability Tests

We tested convergent and discriminant validity of all reflective variables with widely acknowledged tests. For convergent validity, we calculated the AVE for all reflective variables. All AVE values are greater than .50 (minimum .722, see Table II-19). Thus an adequate convergent validity is established for all reflective variables (Fornell and Larcker 1981). For discriminant validity, we conducted three tests. First, we used the Fornell and Larcker criterion (Fornell and Larcker 1981), which suggests that the root square of AVE is bigger than the correlation between the latent variables. Table II-21 shows that all reflective variables fulfill this criterion in our model. Second, we verified that the loadings of all items load highly on their item (i.e., > .707 (Chin 1998)) and exceed all cross loadings by at least .10 (Gefen and Straub 2005). Table II-22 displays the loadings and cross loadings and shows that this criterion is fulfilled as well.[5] Third, we calculated HTMT ratio for all factors (see Table II-20). All HTMT values are below or equal .85 and confirm the discriminant validity of all reflective variables (Henseler et al. 2015). All tests confirm convergent and discriminant validity for all reflective variables in our model.

Reliability was tested for all reflective variables with three indicators: Cronbach's Alpha (Cronbach 1951), construct reliability (Fornell and Larcker 1981) and ρ_α (Dijkstra and Henseler 2015b). Table II-19 shows that all three indicators are higher than .70, which indicates a good construct reliability for the reflective variables (Henseler et al. 2016; Netemeyer et al. 2003).

Constructs	**Items**	**CR**	**CA**	**AVE**	**ρ_α**
Affordance Actualization	4	.943	.942	.805	.945
Being Pushed Affordance Perception	3	.900	.901	.752	.910
Exploring Affordance Perception	3	.942	.942	.844	.942
Imitating Affordance Perception	3	.898	.898	.745	.899
Transferring Affordance Perception	3	.950	.950	.863	.950
Deliberate Initiatives	3	.916	.916	.784	.917
Other People's Use	3	.939	.940	.838	.943
Self-Efficacy	3	.883	.883	.716	.890
Controls					
Sense of Power	4	.911	.911	.722	.923
Technical Knowledge Team	3	.949	.948	.862	.948
Ease of Support	3	.950	.950	.864	.951
Personal Innovativeness with IT	4	.921	.944	.808	.931

CR= Composite Reliability; CA = Cronbach's Alpha; AVE = Average Variance Extracted

Table II-19 Validity and Reliability Indicators for Reflective Variables

[5] The high loadings between the first level variables of the higher order variable (affordance perception) are an indicator of the close relationship between the variables. See "Appendix II-C.5 Validity of Higher-Order Construct: Affordance Perception" for a more detailed test for these items.

Construct	1	2	3	4	5	6	7	8	9	10	11
1. AA											
2. BPAP	.62										
3. EXAP	.65	.64									
4. TRAP	.71	.65	.85								
5. IMAP	.70	.72	.67	.75							
6. DI	.47	.63	.48	.47	.62						
7. OPU	.47	.57	.56	.60	.58	.53					
8. SE	.47	.32	.53	.58	.39	.34	.41				
Controls											
9. EoS	.37	.25	.20	.31	.32	.24	.25	.54			
10. EXP	.38	.28	.42	.46	.41	.33	.27	.42	.11		
11. SoP	.21	.17	.13	.14	.26	.22	.13	.05	.08	.13	
12. TKT	.38	.22	.18	.30	.35	.31	.37	.33	.34	.25	.11

Table II-20 Heterotrait-Monotrait Ratio of first-Order Variables

Constr.	1	2	3	4	5	6	7	8	9	10	11	12
1. AA	**.90**											
2. BPAP	.63	**.87**										
3. EXAP	.65	.64	**.92**									
4. TRAP	.71	.66	.85	**.93**								
5. IMAP	.70	.73	.68	.75	**.86**							
6. DI	.47	.63	.48	.47	.61	**.89**						
7. OPU	.47	.57	.56	.60	.58	.53	**.92**					
8. SE	.47	.33	.53	.58	.39	.34	.41	**.85**				
Controls												
9. EoS	.37	.25	.20	.31	.32	.24	.25	.54	**.93**			
10. EXP	.38	.28	.42	.46	.41	.33	.28	.42	.11	**1.00**		
11. SoP	.21	.17	.13	.14	.26	.22	.13	-.02	-.08	.13	**.85**	
12. TKT	.38	.22	.18	.30	.35	.31	.38	.33	.34	.25	.11	**.93**

Diagonal elements: Square root of AVE; Off diagonal: Correlation among constructs;

Table II-21 Square Root of AVEs and Correlations

	AA	BPAP	EoS	DI	OPU	EXP	EXAP	IMAP	PIIT	SE	SoP	TKT	TRAP
AA1	**.83**	.55	.25	.39	.36	.36	.54	.55	.19	.41	.12	.31	.59
AA2	**.89**	.56	.36	.40	.43	.31	.61	.60	.25	.45	.15	.30	.64
AA3	**.95**	.60	.35	.46	.45	.38	.62	.70	.21	.39	.25	.32	.66
AA5	**.91**	.54	.34	.44	.42	.32	.59	.66	.18	.43	.22	.42	.65
BPAP1	.62	**.96**	.26	.53	.51	.33	.66	.68	.26	.33	.14	.23	.66
BPAP2	.49	**.80**	.22	.54	.49	.18	.49	.58	.13	.26	.12	.16	.50
BPAP3	.51	**.83**	.17	.58	.48	.21	.50	.62	.16	.25	.18	.17	.54
EoS1	.35	.22	**.90**	.22	.21	.10	.16	.30	.03	.49	-.07	.31	.27
EoS2	.33	.23	**.94**	.22	.25	.12	.20	.27	.04	.52	-.04	.32	.31
EoS3	.34	.25	**.95**	.23	.24	.10	.20	.30	.03	.49	-.10	.32	.29
DI1	.42	.52	.18	**.87**	.46	.28	.42	.54	.23	.33	.22	.21	.43
DI2	.41	.56	.18	**.86**	.46	.30	.38	.56	.18	.27	.21	.29	.38
DI3	.43	.60	.27	**.93**	.50	.31	.47	.54	.17	.30	.17	.32	.44
OPU1	.42	.45	.23	.41	**.85**	.19	.49	.49	.19	.37	.11	.32	.54
OPU2	.43	.53	.25	.49	**.92**	.25	.50	.53	.22	.36	.11	.35	.55
OPU3	.44	.57	.21	.56	**.98**	.31	.55	.57	.24	.40	.15	.37	.56
EXP	.38	.28	.11	.33	.28	**1.00**	.42	.41	.30	.42	.13	.25	.46
EXAP1	.61	.56	.20	.46	.50	.38	**.92**	.63	.27	.52	.14	.20	.79
EXAP2	.61	.61	.18	.46	.52	.37	**.91**	.61	.34	.47	.10	.14	.77
EXAP3	.58	.60	.18	.42	.52	.41	**.92**	.62	.38	.49	.12	.16	.78
IMAP1	.58	.58	.29	.57	.51	.35	.51	**.82**	.20	.29	.21	.31	.57
IMAP2	.64	.62	.25	.49	.49	.39	.60	**.87**	.21	.34	.22	.33	.67
IMAP3	.59	.68	.27	.54	.51	.31	.64	**.90**	.16	.37	.23	.27	.71
PIIT1	.25	.17	.06	.19	.20	.28	.32	.23	**.88**	.19	.08	.01	.28
PIIT2	.21	.19	.03	.20	.21	.25	.36	.18	**.97**	.33	.13	-.12	.33
PIIT3	.14	.16	.00	.15	.20	.25	.25	.15	**.77**	.18	.17	-.11	.24
PIIT4	.18	.22	.05	.19	.20	.24	.29	.18	**.82**	.20	.06	-.11	.23
SE1	.40	.25	.46	.22	.34	.33	.44	.30	.24	**.81**	-.06	.30	.48
SE2	.40	.29	.47	.34	.42	.44	.51	.34	.23	**.95**	-.03	.30	.56
SE3	.40	.28	.44	.30	.28	.29	.41	.36	.20	**.78**	.03	.25	.44
SoP1	.15	.15	-.03	.20	.06	.03	.07	.19	.07	-.03	**.74**	.05	.09
SoP2	.18	.17	-.01	.22	.13	.10	.13	.27	.12	-.04	**.96**	.09	.15
SoP3	.18	.15	-.06	.17	.15	.18	.13	.21	.15	-.01	**.89**	.12	.14
SoP4	.20	.10	-.16	.17	.11	.14	.10	.20	.09	.00	**.79**	.09	.11
TKT1	.36	.20	.33	.30	.38	.22	.19	.33	-.08	.31	.08	**.96**	.31
TKT2	.36	.22	.32	.28	.36	.23	.18	.34	-.10	.29	.09	**.94**	.28
TKT3	.33	.18	.30	.27	.30	.26	.14	.31	-.07	.32	.12	**.88**	.25
TRAP1	.67	.62	.27	.43	.60	.45	.79	.73	.32	.54	.16	.32	**.95**
TRAP2	.62	.59	.27	.41	.54	.44	.78	.67	.33	.54	.11	.24	**.90**
TRAP3	.68	.62	.33	.47	.54	.39	.80	.70	.23	.56	.13	.29	**.93**

Test set-up: Algorithm: Consistent PLS; weighting-scheme: factor

Table II-22 Loadings and Cross Loadings

II-B.2.2 Formative Variable: Validity and Reliability Tests

Formative variables have different criteria to validate their validity and reliability (Diamantopoulos et al. 2008). Additionally, all formative variables in our model are higher-order (second or third) variables, which also demands adjusted tests. For validity, we conducted two tests. First, we examined the weights and loadings of the formative variables in our measurement model. Using bootstrapping, we also calculated the significance levels of the weights and loadings. Table II-15 shows that all weights and loadings are significant (< .001) (Hair et al. 2011). Second, we assessed the validity of the formative variables with the adequacy coefficient R_a^2 (Edwards 2001). Table II-23 shows that all coefficients are above .50, which indicates validity on construct level (MacKenzie et al. 2011). Thus, validity should be established. Another issue for formative constructs is multicollinearity (Diamantopoulos and Winklhofer 2001). We conducted a multicollinearity analysis (see "Appendix II-C.3 Multicollinearity Analysis") that showed no issues for the formative variables. Due to their nature, formative variables have no reliability issues (Edwards 2001; MacKenzie et al. 2011). Thus, no test has been conducted regarding reliability of formative variables.

Constructs	**Correlations**	**Calculation**[6]	R_a^2
AAP	Transferring AP: .976 Exploring AP: .915	$\frac{.976^2 + .915^2}{2}$	.895
HAP	Imitating AP: .938 Being Pushed AP: .875	$\frac{.938^2 + .875^2}{2}$	.823
Affordance Perception	AAP: .938 HAP: .924	$\frac{.938^2 + .924^2}{2}$	.867

Table II-23 Adequacy Coefficients for higher-order formative constructs

[6] Formula: "R_a^2 is calculated by summing the squared correlations between the construct and its dimensions and dividing by the number of dimensions" (Edwards 2001, p. 163)

Appendix II-C. Analysis Techniques and Supplemental Statistics

II-C.1 Data Analysis Setups

All PLS-SEM calculations in this paper were calculated with SmartPLS (Ringle et al. 2015). We created several models for the analysis of our data in SmartPLS. Three models were created to conduct specific tests for mediation, multicollinearity and moderators. Furthermore, we needed three models to account for affordance perception (third-order construct), since we applied a two (three)-stage approach (Becker et al. 2012; Wetzels et al. 2009). We used this approach for our reflective-formative variables (heteronomous and autonomous affordance perception) and reflective-formative-formative variable (affordance perception) because we were interested in the higher-order estimates only (Becker et al. 2012). Table II-24 summarizes the three models (three stages) and reports their application and settings for our research. We applied the consistent PLS algorithm (Dijkstra and Henseler 2015b) in the first stage only since all other stages contain formative variables (van Riel et al. 2017). Additionally, all formative variables were set into mode B for calculations.

Model	Algorithm	Bootstrapping	Weighting-Scheme	Special Settings	Used For
1. Stage	Consistent PLS	1000 samples No sign changes	Factor	Mode A for first-order constructs of affordance perception	Latent Factors second-order calculated Measurement Model
2. Stage	PLS	1000 samples No sign changes	Factor	Mode B for formative constructs	Latent Factors third-order calculated Measurement Model
	PLS	1000 samples No sign changes	Path	Mode B for formative constructs	Calculations of the antecedents of AP
3. Stage	PLS	1000 samples No sign changes	Path	Mode B for formative constructs	Calculations of the antecedents of AA

Table II-24 Model Properties and Settings

II-C.2 Vanishing Tetrads Analysis

We conducted a vanishing tetrads analysis to ensure the correct specification of formative and reflective constructs (Bollen and Ting 2000; MacKenzie et al. 2011). We focused on the dependent variables and executed the analysis for affordance perception (3rd order), heteronomous and autonomous affordance perception (2nd order) and affordance actualization. The confirmatory tetrads analysis suggested by Gudergan et al. (2008) was used to conduct the test. A repeated indicator approach (i.e., all latent items directly connected to the latent variable) was used for the affordance perception tests to achieve at least four items (prerequisite for vanishing tetrads analysis) (Becker et al. 2012). The test setting for all tests were 5000 subsamples for bootstrapping and a two-tailed test on the significance level of .05. The test confirmed that affordance perception and its categories (autonomous and heteronomous AP) are formative variables. For affordance actualization, the test showed problems with the composition of the variables. Two tetrads were found that let us suggest that affordance actualization is a formative construct although we developed it reflective. We removed item AA4 from our model since this item was present in all "formative" tetrads and re-ran the test. This follow-up test confirmed the reflective nature of affordance actualization. Table II-25 summarizes the results of the second test for the variables and shows the minimum p-value level for the reflective variables and the number of tetrads below the .001 confidence interval (values below .05 for at least one tetrad is an indicator for a formative variable (Bollen and Ting 2000)). The test results support that the causal structures of the variables are specified as intended in our model.

Latent Variable	p-value	Formative or Reflective
Affordance Actualization	> .100 (minimum)	Reflective
Affordance Perception	< .001 for eleven tetrads	Formative
AAP	< .001 for three tetrads	Formative
HAP	< .001 for two tetrads	Formative

Test set-up: Subsamples: 5000; Test type: Two-tailed: 0.05

Table II-25 Vanishing Tetrads Analysis Results

II-C.3 Multicollinearity Analysis

Beside the full collinearity analysis (see section "Appendix II-C.6.2 Common Method Bias Test"), we also conducted a multicollinearity analysis on variable level. Thus, we calculated the VIF for all items. We conducted this test in two phases. First, we calculated the VIF for all first-order constructs and their items. Table II-26 present the results of this test. All VIF values are below ten, which suggests that no multicollinearity issues exist (Petter et al. 2007). Second, we calculated the VIF values for the higher-order formative constructs. Table II-27 present the results of this test. No values are above 2.9. Thus, the items fulfill the stricter standards (VIF < 3.3) for formative variables under PLS-SEM (Diamantopoulos and Siguaw 2006; Kock and Lynn 2012). We conclude that multicollinearity is no issue in this study.

Item	VIF	Item	VIF	Item	VIF
AA1	3.126	IMAP3	2.344	OPU3	3.267
AA2	4.399	TRAP1	4.899	TKT1	7.656
AA3	4.259	TRAP2	5.566	TKT2	9.574
AA5	5.086	TRAP3	4.676	TKT3	3.496
BPAP1	2.256	SE1	2.915	ESU1	6.529
BPAP2	3.479	SE2	2.267	ESU2	5.766
BPAP3	3.765	SE3	2.492	ESU3	4.078
EXAP1	4.243	DI1	2.762	SoP1	3.917
EXAP2	7.603	DI2	4.085	SoP2	4.672
EXAP3	4.524	DI3	3.456	SoP3	2.970
IMAP1	3.032	OPU1	5.634	SoP4	2.446
IMAP2	3.334	OPU2	7.105		

Test set-up: consistent PLS algorithm; all items connected; weighting-scheme: factor. AA4 removed previously because of vanishing tetrads tests (see Table II-25 for details).

Table II-26 Reflective First-Order Items VIF Values (before deletion)

Item	Related Construct	VIF
Exploring AP	AAP	2.829
Transferring AP	AAP	2.829
Being Pushed AP	HAP	1.744
Imitating AP	HAP	1.744
AAP	Affordance Perception	2.168
HAP	Affordance Perception	2.168

Table II-27 Formative Higher-Order Items VIF Values

II-C.4 Interaction Effect Analysis

We tested our model for mediation and moderation effects to ensure to ensure the correct specification of our model (i.e., the absence of unspecified interaction effects) (Gefen et al. 2011). The results are presented in the following sections.

II-C.4.1 Mediation Effects

We conducted a mediation effect analysis (Mackinnon et al. 2004) to identify for underlying causal relationships between variables. We focused on the three influence factors for affordance perception and their effect on affordance actualization but also included all control variables. Table II-28 summarizes the results for the three influence factors.[7] A mediation effect exists, if the indirect effect is significant in bootstrapping analysis (Zhao et al. 2010). The results support the assumed indirect-only effect of these factors on affordance actualization and the correct specification of our structural model. We also found indirect-only (full) mediation effects for all control variables.

	Coefficient	Standard Error	p-value	Mediation
DI -> AA				
Indirect Effect	.188	.065	.004	Indirect-only (full) Mediation
Direct Effect	.007	.069	.924	
Total Effect	.195	.089	.029	
OPU -> AA				
Indirect Effect	.240	.072	< .001	Indirect-only (full) Mediation
Direct Effect	-.054	.088	.542	
Total Effect	.187	.109	.088	
SE -> AA				
Indirect Effect	.135	.053	.010	Indirect-only (full) Mediation
Direct Effect	.050	.080	.528	
Total Effect	.186	.092	.044	
SE -> AP				
Indirect Effect	.207	.077	.007	Indirect-only (full) Mediation
Direct Effect	.001	.006	.855	
Total Effect	.208	.077	.007	
OPU -> AP				
Indirect Effect	.355	.081	< .001	Indirect-only (full) Mediation
Direct Effect	.001	.005	.859	
Total Effect	.355	.081	< .001	
DI -> AP				
Indirect Effect	.270	.087	.002	Indirect-only (full) Mediation
Direct Effect	-.001	.007	.913	
Total Effect	.269	.088	.002	

Test set-up: PLS algorithm; weighting-scheme: factor; bootstrapping: 1000 samples

Table II-28 Mediation Analysis for All Exogenous Variables

[7] We removed all other variables from the model to conduct this part of the mediation analysis, which leads to different correlations between the variables compared to our overall tests.

II-C.4.2 Moderation Effects

We did not theorize moderation effects in our model. However, we conducted an exploratory moderation effect analysis for all endogenous variables (AAP, HAP and AA). For this purpose, we calculated the moderating effects for all combinations of independent variables related to the dependent variables in our structural model. Furthermore, we tested PIIT as additional possible moderating factor. Overall, we calculated 31 moderating effects in the model. For each endogenous variable, we created all possible combinations of independent variables as moderators (method: product indicator calculation) and conducted bootstrapping. We discarded all non-significant combinations. Two combinations were significant in this exploration. We tested these two moderation effects separately in our structural model and conducted bootstrapping again. In this set-up, none of the two combinations was significant. Thus, we conclude that moderation effects are absent of our structural model.

II-C.5 Validity of Higher-Order Construct: Affordance Perception

We put special efforts in the validation of the affordance perception measures because all items were newly developed and the distinction between the elements is important for our theory. Therefore, we conducted additional validity tests for the four affordance perception mechanisms (see chapter “Appendix II-B.2.2 Formative Variable: Validity and Reliability Tests” for the other validity tests).[8] First, we executed an exploratory factor analysis (EFA applying the principal component extraction method with equamax rotation. Table II-30 shows that the EFA extracted two components (heteronomous and autonomous affordance perception) with high loadings (> .64), which provides support for the validity of the second-order variables. Then, we wanted to verify the validity of the mechanism items. Therefore, we conducted factors analysis with forced number of factors ranging from one factor to six factors (applying maximum likelihood extraction method with equamax rotation). This allows us to compare the different models with chi-square difference tests (Gefen et al. 2000). Table II-29 shows the loadings of these models and that in the model with four factors all items from different mechanisms load highly on separate constructs. Table II-30 shows the

[8] The inspiration for these tests are from the work of Schmitz et al. (2016), who faced similar issues regarding the distinction of highly related variables, although they do not handle higher order formative constructs.

results of the chi-square difference tests. These have been significant until the comparison of the five and six factor model, which suggests that the five factor model is the most parsimonious model. However, the four mechanisms load for the four and five factor model on distinct components (in the five factor model one component has values below .22 for all items). Thus, we conclude that this also supports the validity assumption for our four mechanisms.

Items	**Component 1**	**Component 2**
IMAP1	.375	**.665**
IMAP2	.483	**.648**
IMAP3	.513	**.667**
BPAP1	.185	**.855**
BPAP2	.203	**.871**
BPAP3	.442	**.730**
EXAP1	**.859**	.268
EXAP2	**.854**	.290
EXAP3	**.841**	.298
TRAP1	**.815**	.393
TRAP2	**.838**	.325
TRAP3	**.826**	.371

Test set-up: Extraction method: Principal Component; Rotation: Equamax; Calculation with SPSS 25

Table II-29 Rotated Component Matrix: Affordance Perception Items EFA

	Number of Factors															
Items	**1**	**2**		**3**			**4**				**5**					**6**
IMAP1	X	X				X	.19	.19	.24	**.81**				X		-
IMAP2	X	X			X		.23	.29	.27	**.78**				X		-
IMAP3	X	X			X		.26	.36	.40	**.60**				X		-
EXAP1	X	X		X			**.71**	.43	.20	.26			X			-
EXAP2	X	X		X			**.89**	.31	.25	.22			X			-
EXAP3	X	X		X			**.72**	.41	.23	.26			X			-
TRAP1	X	X			X		.40	**.72**	.26	.35	X					-
TRAP2	X	X			X		.38	**.79**	.22	.28	X					-
TRAP3	X	X			X		.43	**.71**	.27	.30	X					-
BPAP1	X		X			X	.33	.31	**.61**	.34		X				-
BPAP2	X		X			X	.17	.17	**.81**	.24		X				-
BPAP3	X		X			X	.17	.18	**.88**	.24		X				-
χ^2	563.35	346.18		180.311			62.410				32.785					12.81
df	54	43		33			24				16					9
$\Delta\chi^2$	-	217.17		165.87			117.90				29.63					9.98
Δ df	-	11		10			9				8					7
p-value	-	< .001		< .001			< .001				< .001					> .20

Test set-up: Extraction method: Maximum Likelihood; Rotation: Equamax; Calculation with SPSS 25

Table II-30 Factor Loadings for Affordance Perception Items and Chi-Square Difference Test

II-C.6 Bias Tests

II-C.6.1 Non-Response Bias Test

We conducted a non-response bias test based on the last-wave method (Armstrong and Overton 1977). Therefore, we separated the sample into four groups of equal size (group size: 38) and conducted an independent samples t-test for the demographic properties (i.e., education, tenure, gender and age) between the first and the last quartile. The results suggest that there are no significant differences between the two groups (see Table II-31). We achieved similar results by separating the sample based on the reminder date splitting the sample in only two groups. Thus, we assume that non-response bias is not a problem in this analysis.

	t-value	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	Upper
Education	-.852	75	.397	-.258	.303	-.861	.345
Tenure	-1.070	75	.288	-.243	.227	-.695	.209
Gender	.026	75	.979	.001	.051	-.101	.103
Age	-.763	75	.448	-.296	.387	-.067	.476

Test set-up: Independent-sample t-test in SPSS 25

Table II-31 Independent-sample T-test for First and Last Quartile Waves

II-C.6.2 Common Method Bias Test

We tested also for common method bias. We used two tests to identify possible common method bias. First, we executed Harman's single factor test (Podsakoff et al. 2003). We conducted an EFA with all latent factors (including control variables) and without restrictions, which identified ten components. Afterward, an EFA restricted to a single factor was calculated. This factor accounted for 32.9% of the variance. These results show that no single factor emerges from the unrotated solution and no single factor accounts for more the 50% of the covariance. Thus, the Harman's single factor test suggests no common method bias problems for this study. Although this method has been widely used, its results are criticized (Podsakoff et al. 2003). Thus, we conducted a full collinearity analysis, which is suggested for PLS-SEM (Kock 2015; Kock and Lynn 2012). We followed the set-up suggested by Kock and Lynn (2012) and created a dummy variable with random values. Then we created a model, connected all latent variables (without controls) with the dummy variable and calculated the VIF (see Table II-32). The test showed that there were no collinearity issues, since all VIF values were below the threshold of 3.3 (Kock 2015). These results let us suggest that common method bias is not a problem in this study.

Latent Constructs	VIF
Affordance Actualization	1.377
Affordance Perception	1.106
Deliberate Initiatives	1.092
Other People’s Use	1.309
Self-Efficacy	1.030

Test set-up: PLS algorithm, weighting-scheme: factor.

Affordance perception based on repeated indicator approach using the first-order latent variables.

Table II-32 Results Full Collinearity Test (Dummy Variable)

CHAPTER III ROUTINE CHANGE UNDER MALLEABLE INFORMATION TECHNOLOGY

STUDY 3 CHANGE OF ORGANIZATIONAL ROUTINES UNDER MALLEABLE INFORMATION TECHNOLOGY: EXPLAINING VARIATIONS IN MOMENTUM[9]

Tim Lehrig, Oliver Krancher

Abstract

Malleable technology bears the promise of allowing users to flexibly change organizational routines. Although the benefits from malleable technology depend on the extent to which users make use of such technology to change organizational routines, we know little about the factors that shape the intensity of routine change. We report the results of a case study in which we analyzed changes of 24 routines under malleable technology over a period of three years. Our results show that actors often perform a series of consecutive changes rather than one discrete change. We build on the concept of momentum to describe the intensity of these changes. Our emergent theory suggests that momentum is affected by the embeddedness of routines, by existing artifacts, by lead actor traits, and by external knowledge. Our study contributes to theory of routine change by developing explanations for variations in momentum of routine change under malleable technology.

Keywords: Momentum, Organizational Routines, Artifacts, IT-enabled Change, Malleable IT

[9] An initial idea for this study was published at ECIS 2015 as research in progress (Lehrig et al. 2015).

1 Introduction

The relationship between organizational routines and information technology (IT) has always been of key interest to information systems and organizational scholars alike (e.g., Becker 2004; D'Adderio 2011; Edmondson et al. 2001). Recently, attention has focused on the change of routines that is enabled by IT (e.g., Berente et al. 2016; Goh et al. 2011; Leonardi 2011; Polites and Karahanna 2013). Theory of IT-enabled routine change has become of increasing practical relevance given the increasing diffusion of *malleable IT* (i.e., IT that users can modify on their own) (Kallinikos et al. 2013; Richter and Riemer 2013; Schmitz et al. 2016). Malleable IT bears the promise of allowing actors to flexibly change artifacts and the routines supported by the artifacts. Yet, this puts a high burden on actors. Since routines are patterns of interdependent work that involves multiple actors (Feldman and Pentland 2003), actors may typically need to perform a series of consecutive changes to the routine and to artifacts until they arrive at a new version of the routine that satisfies all involved actors' needs and that leverages the potential offered by the malleable IT. In this paper, we explore such series of consecutive changes, aiming to explain why they occur with different intensity under different conditions.

The literature on routines and artifacts provides some insights into IT-enabled change of routines, focusing on the nature of change, the role of artifacts, and the factors that affect the intensity of change. The routine literature suggests that routines change due to exogenous events, such as when a new technology becomes available (Edmondson et al. 2001), and due to endogenous dynamics, such as when actors learn from past performances of the routine and strive to do better (Feldman 2000; Feldman and Pentland 2003). Artifacts play an important role in both types of change. Artifacts may be a source of exogenous change when they afford new ways of performing the routine (Leonardi 2011). But artifacts also shape endogenous change, such as when the tight entanglement of artifacts and the routine makes it more difficult for actors to change the routine, or when the use of the artifact yields outcomes (e.g., learning) that subsequently enable new ways of performing the routine with the artifact (D'Adderio 2011; Goh et al. 2011; Leonardi 2011). Indeed, studies of IT-enabled change show that the availability of a new artifact is often followed by a long process in which actors perform a series of consecutive changes to routines and to artifacts, emphasizing the key role of endogenous change (e.g., Boudreau and Robey 2005; Goh et al. 2011; Leonardi

2011; Orlikowski 1996; Volkoff et al. 2007). While much research focusses on the nature of change and the role of artifacts, a few studies have turned their attention to the intensity of change. Jansen (2004) examined the *momentum of change*, loosely defined as the energy or force associated with a change (p. 277). She found that momentum depended both on top-down sources, in particular the change leader's commitment, and on bottom-up sources, in particular social interaction through which individuals gain support from other individuals. Other work did not use the term momentum but also examined factors that affect the intensity of routine change. These factors include actor characteristics, such as innovativeness (Goh et al. 2011), intention, and orientation (Howard-Grenville 2005), and characteristics of the routine, in particular its embeddedness (Howard-Grenville 2005). Embeddedness, defined as the degree to which the routine overlaps with other organizational structures (Howard-Grenville 2005), is argued to constrain change.

While these studies have yielded important insights into routine change and the role of IT, our knowledge about the routine change associated with malleable IT is limited in three important regards. First, there is little research on the momentum of routine change under malleable IT. Although the work on momentum by Jansen (2004) is potentially informative, her study focused on organizational level strategic change. In contrast to such a rather macro-level focus, it is likely that routine change enabled by malleable IT is characterized by a stronger focus on micro-level, bottom-up processes in which the actors involved in the routine initiate changes to the routine and to the technology. Second, although the routine literature emphasizes embeddedness as a factor that influences momentum (Howard-Grenville 2005), the literature concentrates on strongly embedded routines, such as consulting routines in hospitals (Goh et al. 2011) and procurement routines (Berente et al. 2016). Strongly embedded routines often involve individuals from many departments and are, hence, relatively inert. Yet, many routines that are suitable for malleable IT are weakly embedded, such as the coordinated organization of documents or tracking of open issues. Third, the literature remains silent about the role of pre-existing artifacts. Nowadays, many routines are already supported by some type of IT artifact. Yet, many studies focus on situations in which organizations replace existing artifacts by completely new ones (e.g., Berente et al. 2016; Edmondson et al. 2001; Goh et al. 2011). Such disruptive changes naturally generate momentum given that actors have to find ways to perform the routine without their previous artifacts. However, in the case of malleable IT, actors can often incorporate existing artifacts into new versions of a routine, such that the new routine relies on both the malleable IT and the existing artifact. Given these three gaps, it is unclear what affects the momentum of routine change under malleable IT. This lack of knowledge is unfortunate given that malleable IT will often require a series of consecutive changes from actors (e.g., changes to the configuration of the malleable IT, changes of the routine) before the actors fully leverage the potential offered by the malleable IT. Without sufficient momentum, these change processes become stuck or may not even start. Knowledge about the factors that influence momentum is thus important if organizations wish to fully leverage the potential for improving organizational routines that is offered by malleable IT.

Our study addresses the following research question: *Why does the momentum of routine change associated with malleable IT varies between routines?* To answer this question, we conducted a case study in an organization that implemented Microsoft SharePoint (SP), a malleable IT product that invites configuration by end users and that aims at supporting interdependent work. Our primary data source were 59 interviews conducted with 14 users over a period of more than three years. We identified 24 routines and the changes to these routines and to the SP based artifacts that the actors used in these routines. Based on these data, we identified four factors that affect momentum of routine change: embeddedness of routines, the relationship to existing artifacts, lead actors' personal traits, and external knowledge. We analyzed different combinations of these factors and identified five configurations of factors associated with particular levels of momentum. Our key contribution is an emerging theory of the momentum of IT-enabled routine change under malleable IT.

The remainder of this paper is organized as follows. We next review the literature on organizational routines and, in particular, on the role of artifacts in organizational routines. We then present our methods, findings, and our emerging theory before we discuss implications and contributions.

2 Related Literature

We base our research on the existing organizational routine literature. We next review the literature on organizational routines and their change. We then review the relationship between artifacts and organizational routines and their change.

2.1 Organizational Routines and Change

Organizational routines (in brief: routines) are defined as "repetitive patterns of interdependent organizational actions" (Parmigiani and Howard-Grenville 2011). Examples of routines include hiring people at a university (Feldman and Pentland 2003), conducting crash tests at an automaker (Leonardi 2011), and patrolling transit operations at a law enforcement organization (Glaser 2017).

Given that the concept of routines focusses on what organizations repeatedly do, it is not surprising that routines have a long lasting history in organizational research (Becker 2004). During this period, their conceptualization has advanced from being a source of stability (Cyert and March 1963; Nelson and Winter 1982) to being a source of stability and change (Feldman 2000; Feldman and Pentland 2003). In their seminal work, Feldman and Pentland conceptualize routines as generative systems and explain why routines endogenously change over time (Feldman and Pentland 2003). They argue that routines change because actors aim to "repair" problems in the routine, because actors strive to improve the routine, because actors improvise to cope with particular circumstances in particular executions of the routine, and because actors learn from past performances of the routine (Feldman 2000; Feldman and Pentland 2003).

Although the foundational work by Feldman and Pentland explains why routines can change, it does not aim to explain why the intensity of routine change varies. Important insights into the mechanisms that affect the intensity of routine change have come from Jansen's (2004) study of momentum in strategic change. She introduced the concept of *change based momentum*, which describes "the energy associated with pursuing a new trajectory" (p. 277). Thus, high change based momentum (or in short: high momentum) describes situations where strong forces are present to substantially transform the way how a routine is performed. Conversely, low momentum describes situations where the forces that aim to initiate changes to a routine are weak and, hence, at best minor changes to a routine materialize.

The concept of momentum is particularly promising in the context of IT-enabled routine change because IT implementation studies found that actors often perform a long series of changes to the routine and to the technology before they arrive at a satisfactory new version of the routine. This suggests that high momentum is often required to allow teams or organizations to leverage the full potential that a technology offers, because only high levels of energy will allow the actors to accomplish the long series of changes. Conversely, when momentum is low, attempts to improve a routine will become stuck at early stages or not even materialize. Explaining momentum is thus critical for explaining the impact associated with a technology.

Existing research provides some insights into factors that affect momentum (although not in the context of malleable IT). In her study, Jansen (2004) found that at early stages, momentum depended strongly on top-down sources, in particular the change leader's commitment, while at later stages bottom-up sources, in particular social interaction through which individuals gain support from other individuals, turned more important. Moreover, momentum was lower when the trajectory gap, defined as the distance of the current state and the goal state, was high. Other work did not use the term momentum but also examined factors that affect the intensity of routine change. Work on agency emphasizes the key role of actors and their characteristics (e.g., Feldman 2003; Leonardi 2011), while work on embeddedness emphasizes the nature of the particular routine (e.g., Howard-Grenville 2005; Polites and Karahanna 2013), as we will point out next.

A*gency*, is the "capacity for action" (Giddens 1984). More specifically, agency attributed to actors (human agency), is a person's ability to form and realize own goals (Giddens 1984). By enacting their agency, actors can change routines. For example, a human resource (HR) representative may need to conduct an interview (*goal*) in a hiring routine. The standard way of performing the routine may be that the HR representative interviews the applicant in person. However, since this applicant lives abroad, an interview in person is not possible. Thus, the HR representative can enact her agency and alter the routine to conduct the interview in a video call. Researchers identified different personal traits of actors that are beneficial for enacting agency, such as the actor's innovativeness (Goh et al. 2011) or the actor's future orientation (Howard-Grenville 2005). Thus, we expect differences in change induced by personal traits of leading actors.

Embeddedness is the degree the routine overlaps with different organizational structures, including technology, control and coordination systems, and norms (Howard-Grenville 2005). For example, medical surgeries are routines of strong embeddedness since they are based on control and coordination structures that manifest in detailed plans how to conduct the surgery. Researchers see embeddedness as a hindering factor for routine change (Feldman 2003; Howard-Grenville 2005). In this paper, we focus on coordinative embeddedness, defined as "interdependence of action between multiple actors when accomplishing a complex task" (Howard-Grenville 2005, p. 630). Coordinative embeddedness (henceforth in brief: embeddedness) can constrain changes since changes require consensus among actors. Embeddedness increases the complexity of the consensus building process and, thus, sustains the status quo. The existing literature focusses predominantly on routines of strong embeddedness, such as consulting routines in hospitals (Goh et al. 2011) or procurement routines in governmental organizations (Berente et al. 2016). Routines with strong embeddedness display a low likelihood for change (Howard-Grenville 2005). Conversely, weakly embedded routines are less frequently examined in literature. For these routines, the momentum of change could be much higher since actors can overcome the low coordinative obstacles relatively easily and change the routines and related artifacts. Therefore, we expect higher momentum of change for weakly embedded routines. However, the influence of these factors under malleable IT remains empirically unexplored.

2.2 Artifacts and Organizational Routines

Artifacts are material objects produced by human activity (Pratt and Rafaeli 2006). They shape routines and their change (D'Adderio 2011). Artifacts can manifest in different forms such as in written instructions, physical settings, or software. We focus on digital artifacts (i.e., artifacts based on IT), which differ from other artifacts because they integrate deeply into routines (Volkoff et al. 2007). Thus, digital artifacts, like a form in a software, may have a stronger potential to shape routines than a pure instruction manual. The properties of digital artifacts (henceforth in brief: artifacts) depend on the underlying technology and its application, which includes how easily actors can modify the artifacts. For example, many users can modify a formula in a worksheet (*malleable IT*) but cannot update an SQL statement in a database of an Enterprise Resource Planning (ERP) system (*hard-to-change IT*). When users cannot perform their desired actions using hard-to change IT, they may invent workarounds (Boudreau and Robey 2005). Malleable IT, in contrast, bears the promise of allowing users to change the artifacts to their demands.

Artifacts shape routines by affording or constraining particular behaviors (D'Adderio 2011; Pentland and Feldman 2008). Actors can actualize affordances (i.e., action potentials) offered by the artifact and change the routine by using the artifact in a new way for the routine (Leonardi 2011). For example, actors can use notifications to receive emails on updates instead of frequently checking for updates of a document.

However, actors can also ignore these potentials and leave them unused (Goh et al. 2011). Thus, the pure existence of affordances is not a sufficient condition for high momentum of routine change. Artifacts also shape routines by constraining behaviors. For example, a digital form can enforce predefined options for fields that limit the possible entries. Such configurations of artifacts are the result of the enactment of human agency. Thus, actors inscribe their views into the artifacts (D'Adderio 2011). The artifacts then possess their own agency (material agency) and possess capacity to act on their own (Leonardi 2011). This transition from human to material agency may be paralleled by struggles among competing views of actors (D'Adderio 2011). Thus, actors use the artifact to resolve struggles among them by inscribing logic into the artifact. These struggles may fuel momentum of change.

Over time, artifacts can become the result of repeated inscriptions. Although the agency still is distributed (D'Adderio 2011) or imbricated (Leonardi 2011) between actors and artifacts, it is likely that the material agency steadily increases. Thus, over time, more and more of the logic that underlies the routine is inscribed in the artifact (Volkoff et al. 2007). Similar to coordinative embeddedness, the increasing inscription of logic into artifacts makes future changes more difficult and, hence, less likely (Howard-Grenville 2005). This also holds true for malleable IT since the reversal of changes would create high efforts. Thus, we expect that ongoing inscriptions drain momentum over time.

In summary, recent research has contributed valuable knowledge about change of organizational routines, the role of artifacts in the change process, and factors that affect the momentum of change. However, there is little empirical evidence on the influence of these and potentially other factors on momentum under malleable IT. To explore these relationships, it was paramount to observe routines with varying embeddedness levels and different actors under malleable IT over time. We therefore conduct a longitudinal case study of the momentum of routine change under malleable IT, the method which we present next.

3 Method

We conducted a longitudinal case study (Yin 2003). We chose the case study method because it allowed us to observe the change of routines enabled by malleable IT in real organizations. Furthermore, the case study method was likely to reveal differences in momentum of change between instances of routines, which was important for developing explanations in our emergent theory (Eisenhardt 1989).

3.1 Case Set-up

We chose Alpha, a medium-sized mechanical engineering organization, as the context for our case study. Alpha's primary locations were in Germany and Switzerland, but it also operated offices and factories in several other countries including China and the U.S.. Historically grown, Alpha consisted of highly specialized and autonomous divisions with partly redundant structures, e.g., several research and development units. Given the barriers for collaboration presented by different physical locations and by expertise distributed across divisions, Alpha decided to implement SP in 2013 in order to support coordination in organizational routines within and across the divisions. Being highly configurable, SP offered many potential usage scenarios. Users could create and configure collaboration spaces (called sites) that would support the routines in which they were involved. Given this configurable and generic nature, SP was clearly an instance of malleable IT.

Two characteristics of our case study are important to acknowledge. First, Alpha allowed discretion in the usage of SP and did not prescribe any usage scenarios or routines. Second, the IT department had scarce resources for implementing particular user demands and could only ensure the availability of the SP infrastructure. The IT department had thus little influence on the way how users created and configured their collaboration spaces. Given these two circumstances, it was particularly likely that we would observe bottom-up, user-driven change of routines, rather than top-down, management-driven change.

Our units of analysis were routines. While all routines shared the same underlying technology (SP) and the same organizational context, we expected routines to vary in their momentum of change due to characteristics of the involved actors and of the routine itself.

3.2 Data Collection

We started our data collection in November 2014 shortly before the planned go-live of SP. Our data sources consisted of archival data, which included project documentation and the actual SP sites, and interviews, which were our primary data source. We conducted 59 interviews with 14 users between November 2014 and December 2017 in nine rounds. We selected users from five teams: (1) production planning, (2) internal consulting, (3) quality management, (4) customer care support and (5) research and development (R&D) support. We based our team selection on two factors: Early adoption of SP and high variance of possible routines. The five teams were part of the first adopters of SP at Alpha and provided a broad range of different routines. Within the teams, the key users were our most important interview partners but we also searched for complementary interview partners within the teams during our study. We also had to replace interview partners, since some interview partners left Alpha during our study. We substituted these interview partners with members of the same team and followed up on previously identified routines. Beside these five teams, we also conducted interviews with members of the IT department to learn about current developments regarding SP at Alpha. During the first interview round, we asked the interviewees how they planned to use SP for their routines and about their previous experiences with the technology. Furthermore, we asked them about the set-up of their teams and their perception of the organization regarding change and particularly IT-enabled change. After the first interviews, we scheduled the subsequent interview rounds on intervals of three to five months. In these interviews, we asked the users to report important changes related to SP, e.g., trainings or management decisions. If they mentioned routines that were supported by SP, we inquired into potential changes in these routines. The interviews took between 30 and 120 minutes. We used the archival data for triangulation. For example, we asked for the sites related to the routines and analyzed them for changes. We documented the sites through screenshots and used them in following interviews to stimulate conversations.

3.3 Data Analysis

We followed an inductive data analysis approach (Eisenhardt 1989). The process consisted of four steps. First, we created write-ups of the interviews. Second, we identified routines in our data. We coded a routine when a user described recurrent organizational activities, for which she used SP. For example, one user reported that his team used SP to organize documents in projects. Then we searched and coded artifact changes for these routines. For example, the same user reported in a later interview that his team changed SP and added an additional column in the library to organize documents by events. Artifact change describes structural changes on the artifact (e.g., adding a column) and not the usage of the existing artifact, (e.g., adding a row in a table). Based on the codes, we created visual maps (Langley 1999) for each routine to visualize the changes and related events. Third, we developed a classification scheme for changes by comparing instances of changes (Glaser and Strauss 1967). We elaborated categories out of these classifications and displayed them in an ordinal scale with following values: minor, moderate and major change. Fourth, we built explanations for different momentum of change based on these categories. To this end, we compared momentum of change between different routines over time. We conducted step three and four iteratively. Thus, we developed potential categories and dismissed or retained them and used the different categories to build our explanations. Furthermore, we relied on investigator triangulation (Yin 2003) by regularly discussing preliminary results in our research team and giving our raw data to independent students for analysis. We also compared our unfolding findings with the routine literature (theoretical integration) (Eisenhardt 1989).

4 Findings

We observed remarkable differences in the momentum of change between routines. For the ease of presentation, we begin by introducing the constructs that explain these differences according to our analysis. We then present our emerging theoretical model, which identifies five configurations of factors that differ in the resulting momentum of change, and we illustrate each configuration with one routine.

4.1 Constructs

Momentum of Change. Our data analysis pointed us to the usefulness of the concept of momentum of change, as introduced by Jansen (2004). Although we define momentum of change, in line with Jansen's work, as the energy associated with changing a routine, we needed to operationalize the construct in a way that reflects the context of our study. Our analysis suggested that, in our study, momentum of change manifested through two dimensions. The first dimension was the complexity of a single change, which can be minor, moderate, or major (see Table III-1 for definitions of change complexity). Changes of high complexity require (and thus indicate the presence of) high amounts of energy, much like changing the direction of motion of heavy objects requires high amounts of energy. The second dimension is the frequency of these changes. Making a long series of changes requires (and thus indicates the presence of) high amounts of energy, much like throwing an object far requires high amounts of energy. Momentum of change is the combination of these two dimensions. Figure III-2 shows an example of low momentum, where only two minor changes were performed over a period of three years. Figure III-6 shows an example of high momentum, where seven moderate or major changes were performed over the same period.

Our comparison between cases led us to identify the following influencing factors for momentum of change: Relationship to existing artifact, embeddedness of routine, lead actor traits (personal technical knowledge and commitment), and external knowledge. We next define and illustrate these constructs. Table III-2 provides an overview of definitions. Furthermore, we provide coding examples for all influencing factors in "Appendix III-B. Coding Examples".

Change Complexity	Definition
Minor	Actors incorporate out-of-the box functionalities of SP (i.e., functionalities that do not require configuration) in their routine.
Moderate	Actors configure SP standard elements or incrementally configure previously created artifacts and incorporate the configured artifact into the routine.
Major	Actors configure and combine several functionalities and/or technologies for the first time and incorporate the created artifact into the routine.

Table III-1 Change Complexity

Relationship to Existing Artifact. Momentum of change depended on the relationships to existing artifacts (i.e., the ways in which actors related SP to the artifacts that actors used before starting to use SP). We observed three different relationships to existing artifacts: incorporation (existing artifact enhanced with SP), replacement (logic of existing artifact inscribed to SP), and absence (no existing artifact). In *incorporation*, users left the existing artifact unchanged but integrated or supplemented it with SP. For instance, in the machine reservation routine, actors used a worksheet (*existing artifact*) to execute the routine. The actors then uploaded the worksheet to SP to improve access and to enable notifications about updates. The new routine thus relied on both the existing worksheet and on SP. In *replacement*, actors transferred the business logic from the existing artifact to SP and abandoned the existing artifact. For example, in the experimental trial documentation routine, the actors abandoned the file share (*existing artifact*) and transferred its business logic to SP. In *absence*, there is no existing artifact. For instance, a quality manager wanted to enable the organization to share information about production norms. Since no artifact existed, he created a SP library to store and to structure the production norms.

Construct	Definition
Embeddedness of Routine	Interdependence between tasks of multiple actors within the routine. Conceptualized with specialization of actors in the routine and the level of the routine within the organization: Team, department or whole organization.
Relationship to Existing Artifact	The way how actors relate the new malleable IT to existing artifacts (i.e., artifacts that actors used as part of the routine before starting to use the new malleable IT).
- Incorporation	The existing artifact, as a whole, is integrated into or supplemented by malleable IT. Malleable IT thereby extends the existing artifact with new functions. The existing artifact remains part of the routine.
- Replacement	The business logic from the existing artifact is transferred to malleable IT. The existing artifact is abandoned.
- Absence	No existing IT artifact is part of the routine.
Personal Traits	Personal capabilities of lead actors of the routine.
- Personal Knowledge	The lead actor's technical knowledge about malleable IT.
- Commitment	The extent to which the actor is willing to expend effort and energy to improve the routine.
External Knowledge	Active involvement of actors, who have no relationship to the routine, in the configuration of malleable IT.

Table III-2 Construct Definitions

Embeddedness of Routines. Momentum of change also depended on the embeddedness of routines. In our data analysis, we operationalized embeddedness as a two-dimensional construct. The first dimension refers to the level at which the routine is performed, which can be team, department, or organization. At higher levels, routines display stronger embeddedness since it is more likely that actors with different competencies and interests are involved. For instance, the investment controlling routine involved controllers from different business units of the organization and required the integration of figures from all these business units. This routine was, hence, at the organizational level. An example for a routine on team level was the process management routine. The quality managers created a repository for all documented processes and managed it within their team. The second dimension refers to the degree of specialization of the tasks that are part of the routine. Specialization refers to the difficulty with which actors can be replaced by other actors in the performance of the tasks that are part of the routine. Specialization is high if many tasks require to be executed by specific actors. Higher specialization means stronger embeddedness of the routine because the routine requires coordination among the specialists. An example of high specialization was the product portfolio management routine. In this routine, product managers had to provide detailed information about their products-information that only these particular product managers were able to provide. An example for low specialization was the company report routine. In that routine, three secretaries composed a company report. Any secretary could update the document and finalize the report. We coded embeddedness as strong when actors had to interact at least on department level and if specialization was high. Otherwise, we coded embeddedness as weak.

Lead Actor Traits. Momentum of change also depended on lead actor traits. Lead actors were actors (either a single person or a small group) that performed the routine and initiated the use of SP for the routine. We identified two important lead actor traits that affected momentum of change: Personal knowledge and commitment. *Personal knowledge* refers to the lead actor's knowledge about malleable IT. Lead actors with strong technical knowledge were able to configure SP based on their demands. Actors with low technical knowledge had a limited amount of experience and were able to use only out-of-the box functionalities of SP. Actors with medium personal knowledge were able to conduct a narrow range of configurations that they had experienced before. Actors with high personal knowledge were able to conduct a wide range of configurations and learn new configurations on their own. *Commitment* denotes the lead actor's willingness to expend energy and effort to improve the routine. While in some cases lead actors were highly committed to improving routines and to having performed the artifact changes that are necessary to this end, in other cases lead users lacked commitment, often because the routine was not of high importance to them. An example of high commitment was the manager of the consulting team that performed the project organization routine. The manager placed high importance on providing other project members with effective project management templates. He, hence, did not eschew efforts to develop the artifact in order to achieve this goal. An example for low commitment was the lead actor in the machine reservation routine. She created the initial artifact with SP but did not see it in her responsibility to configure the artifact further.

External Knowledge. Momentum of change also depended on external knowledge. By external knowledge, we mean the active involvement of actors that had strong technical knowledge of SP but that were not involved in the routine (hence qualifying as external). In our data, lead actors often had to initiate the contact to and mandate changes to such external resources. For example, the lead actor in the helpline routine searched for help to configure SP and found it by a SP consultant.

4.2 Model

Our analysis revealed five configurations that led to three different levels of momentum. Our model in Figure III-1 displays these configurations by showing five paths starting on the left-hand side with “Relationship to Existing Artifact” and ending on the right-hand side with the level of momentum. Each path presents one configuration. We present each configuration in the subsequent paragraphs, including one example routine in detail. For each example, we also visualize the routine changes in Figure III-2 to Figure III-6. In these diagrams, the primary axis shows when changes occurred while the secondary axis shows the complexity of the change (see Table III-1 for definitions). Table III-3 summarizes the configurations and the resulting momentum for all examples. Additionally, we provide an overview of all identified routines, their momentum and configurations in Appendix III-A.

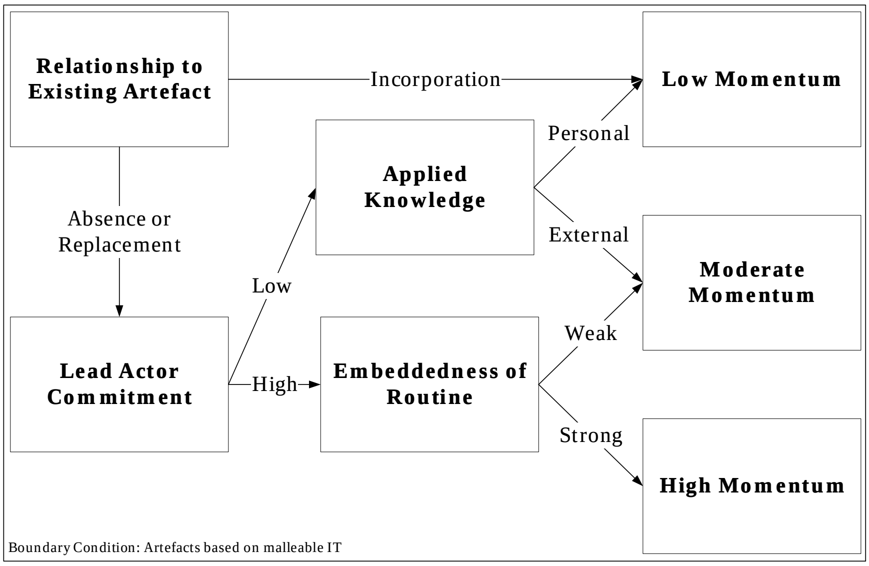


Figure III-1 Emergent Theory of Momentum of Change

Configuration	Momentum of Change	Embed-dedness	Relation to Existing Arti-fact	Commit-ment	Knowledge (Personal or External)
Dominant Existing Artifact	**Low**	Weak	*Incorporation*	Low	Low
Quick Win	**Low**	Weak	*Absence*	*Low*	*High*
External Knowledge Infusion	**Moderate**	Weak	*Replacement*	*Low*	*External*
Dominant Lead Actor	**Moderate**	*Weak*	*Replacement*	*High*	High
Complex Change	**High**	*Strong*	*Absence*	*High*	High

Table III-3 Examples Routine Configurations

4.2.1 Configuration 1: Dominant Existing Artifact

The incorporation of the existing artifact is the dominant property of the first configuration and leads to low momentum of change. We observed six routines that incorporated the existing artifact into SP and displayed similar patterns. One of these routines is the machine reservation routine in the production planning team, which we use as an example to illustrate this configuration.

In the machine reservation routine, production planners and sales people coordinated machine deliveries to customers in China. The existing artifact of the machine reservation routine was a worksheet, which contained all orders and their status. Actors from both teams updated the worksheet whenever the status of an order changed. Once they updated the sheet, they sent the new version to all actors by email. This artifact usage led frequently to inconsistencies in the worksheet.

The production planners became aware of SP in late 2014 and wanted to test the technology in the machine reservation routine: “We are interested in the possibilities of SP especially regarding collaboration in boundary crossing projects.” Therefore, the production planners set up a SP site based on an out-of-the box template including a library to store documents (minor change, see change no. 1 in Figure III-2). In this library, they uploaded the existing worksheet and stored it such that is was accessible to all actors (*relationship to existing artifact: incorporation*). Henceforward, the actors tracked any order status change in the worksheet uploaded on SP. In the beginning, the actors needed to check frequently whether other actors had updated the worksheet, given they did not send emails anymore. To reduce the need for frequent checking, they activated email alerts, a standard functionality of SP that sends notification emails on updates (minor change, see change no. 2 in Figure III-2). No further changes to the routine occurred during the subsequent 2.5 years.

Without changing the routine, the actors forewent potential for improvement. For example, the actors were still unable to update the worksheet concurrently (i.e., only one actor at a time could edit the worksheet). The actors could have replaced the worksheet with a list in SP, which would have allowed editing several rows concurrently. Although the lead actor knew about this possibility, she did not initiate the change since it would have significantly modified the performance of the routine. The other actors would have to understand the unknown feature of SP lists instead of the known worksheet. Thus, they were satisfied with the current artifact and did not invest any further efforts.

In summary, the incorporation of the existing artifact did not provide enough impulse to generate lasting momentum. We conclude that the continued presence of the existing artifact leads to low momentum for two reasons. First, the actors have to adapt their performances only marginally, e.g., open the worksheet from SP and not from email attachment. Thus, they do not feel disrupted in their performances. Second, actors do not have to dive deep into the functionalities of SP since only minor adaptations are required to incorporate the artifact. This draws the attention away from SP and the potentials for change it affords. We term this configuration dominant existing artifact because the continued presence of the existing artifact draws attention away from potential improvements, keeping the momentum for routine change low.

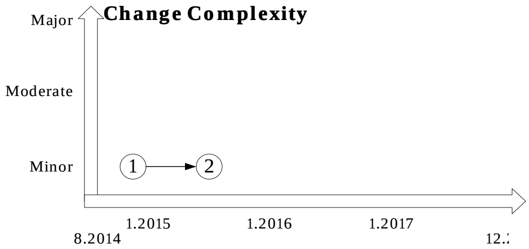


Figure III-2: Machine Reservation Routine

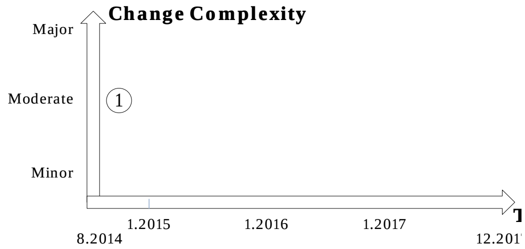


Figure III-3: Event Documentation Routine

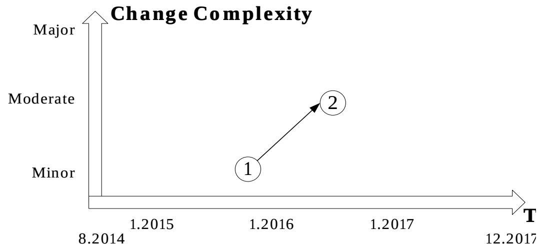


Figure III-4: Experimental Trial Documentation Routine

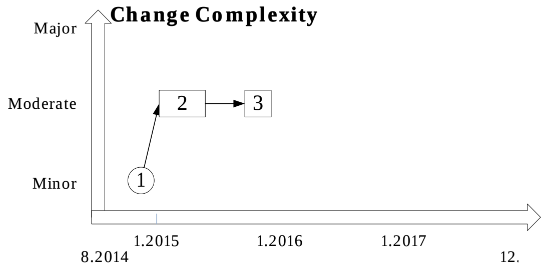


Figure III-5: Project Organization Routine

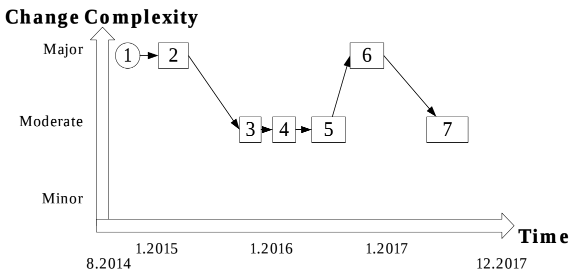


Figure III-6: Product Portfolio Routine

4.2.2 Configuration 2: Quick Win

The second configuration is characterized by the absence of existing artifacts, low lead actor commitment, and high personal knowledge, a combination that led to low momentum of change. We observed two routines that were instances of this configuration. One of these is the event documentation routine in the internal consulting team, which we subsequently use as an example.

The consulting team conducted many workshops, which generated many output documents (i.e., documents that recorded the outcomes of workshops). Since the workshops were parts of bigger projects or programs, an important question for all involved actors was where to store, and find, output documents. No technical solution for this problem existed (*relationship to existing artifact: absence*).

One consulting team member possessed high personal knowledge about SP, which he had gained during his involvement in the SP implementation project (*high personal knowledge*). He realized that a combination of the SP features of pages, views, and metadata could help resolve this problem. He placed all output documents in a central library in SP. For each workshop, he created a page and used views and metadata to display only the relevant outputs of the workshop (moderate change, see change no. 1 in Figure III-3). He used this approach in his projects to document workshops in late 2014. However, as a lead actor, he had no interest to further develop or promote this use of SP since he created it to solve a problem at hand and not to invest into the routine (*low lead actor commitment*). Other actors copied his idea but also perceived it as a quick solution and did not modify or enhance it. The lead actor and those that copied from him made no further changes to the routine during our observation period.

The actors did not leverage the full potential that SP would have offered them in improving their routine. For example, the creation of the event sites required a lot of manual work. One user stated: "It looks really nice but it is too much effort." With additional artifact changes, these steps could have been simplified, standardized, and automated in all instances in which the solution was used. Nevertheless, this was not in the interest of the lead actor, for whom the manual steps were less challenging than for other users. The other users, in turn, did not have access to the knowledge that would have been required to make these improvements.

In sum, when lead actors are knowledgeable but lack commitment, they tend to improve that part of the routine in which they are involved but eschew efforts for helping to improve the other parts of the routine. In other words, they focus on quick local rather than on more effortful global improvements of the routine although their personal knowledge would allow them to move beyond quick local changes. Given this focus on quick short-term gains, we term this configuration quick win. Malleable IT invites quick wins given that artifacts can be modified fast by single users.

4.2.3 Configuration 3: External Knowledge Infusion

Configuration 3 differs from configuration 2 in that the applied knowledge is not the personal knowledge possessed by a lead actor but external to the routine. This configuration led to moderate momentum of change. We observed four routines that were instances of this configuration. One of these routines was the experimental trial documentation routine in the test team of the R&D department.

The test team executed experiments upon requests by customers. In these tests, the test team prepared machines and conducted trials. The team needed to document the tests with pictures and documents to answer the customer requests. Since the work was conducted on team level and specialization in this team was low, this routine qualified as weakly embedded. Before the implementation of SP, the test team stored the pictures and documents on a file share.

A R&D manager, who was not part of the test team, suggested that the test team use SP to support the experimental trial documentation routine. He supported the team with the implementation in late 2015. Initially, he suggested storing the documents on SP instead of the file share (*relationship to existing artifact: replacement*). Therefore, he created a standard site and showed it to the team (minor change, see change no. 1 in Figure III-4). He advertised further advantages of SP, such as full-text search and versioning. In a next step, the manager and the test team discussed ways to improve data organization by metadata, which led to changes in the library structures through configurations (moderate change, see change no. 2 in Figure III-4). After this, the test team migrated all data from the file share to SP to have a standardized structure. Due to automation desires and security concerns, the test team searched for a solution to centralize basic data (e.g., customer names) and to add permissions to certain documents. The manager tried to support the test team also in these demands and suggested some solutions. However, since the experimental trials were not part of his core tasks, he did not invest too much effort in finding solutions and reduced his efforts when he had other, more pressing tasks. The test team members showed no initiative to initiate changes on their own (*low lead actor commitment*). Thus, the actors did not actualize the additional potential for change, such as creating a repository for customer master data or compiling reports from different documents. Although they were aware of the possibility of making these changes, they did not perform them within our observation period.

In summary, when lead actor commitment is low, the presence of external knowledge provide some impetus by showing potentials for improvement of the routine based on the malleable IT. In such scenarios, the combination of external knowledge and the actors' needs leads to moderate momentum for change. Although in particular the external knowledge stimulates the momentum by bringing in ideas, low lead actor commitment and the limited interests of external resources curtail the momentum to a moderate level. We term this configuration external knowledge infusion.

4.2.4 Configuration 4: Dominant Lead Actors

The configuration 4 and 5 differ from configurations 2 and 3 in that lead actor commitment is high. Specifically, configuration 4 combines absence or replacement of existing artifact, high lead actor commitment, and weak embeddedness and leads to moderate momentum for change. We observed seven routines that were instances of this configuration. The project documentation routine, which we subsequently use for illustration, was one them.

The consulting team was a small team of four members, but it conducted many projects within Alpha. Each project was unique while all projects had in common that project members had a need to share information throughout the project. The project members used documents for this purpose and administered the created documents within the project team. The routine was of low specialization given that virtually any actor was able to upload, move or change a document. Therefore, this routine qualified as a routine with weak embeddedness.

Before the implementation of SP, the consulting team administered documents in file shares, which created some problems: "The users forgot the links and were unable to find the documents." The consulting team became aware of SP because one team member managed the implementation project. This project manager became an important source of technical knowledge in his team (*high personal knowledge*) since he learned much about SP during the project and implemented several artifacts based on SP. He initiated the use of SP in his team. At the end of 2014, the consulting team started to manage all new projects with SP. In the beginning, they used standard project sites (minor change, see change no. 1 in Figure III-5) and replaced the folder structures in file shares with libraries in SP (*relationship to existing artifact: replacement*). Beside these out-of-the box functionalities, the consulting team used the metadata columns functionality of SP to define attributes for documents and, thus, make them easier to find. The project managers had the discretion to create and modify metadata to suit their demands in the projects. In the first months, the project managers used this discretion to configure new metadata columns like columns for events or document owners (moderate change, see change no. 2 in Figure III-5). These changes affected the performances of the routine. The actors had to think about who added and changed the metadata, how documents were classified, and how they presented the documents in different views.

The document organization diverged between projects and led to inefficiencies due to diverging ways of using metadata. After a few months, the manager of the consulting team tackled this problem. Since he perceived the project sites in the responsibility of his team (*high lead actor commitment*), he forced his project managers to discuss their experiences. In winter 2015, he stated: “I decided that we will standardize our project sites in SP. … We discussed our experiences and defined a new template for our sites.” This template contained several custom metadata columns (moderate change, see change no. 3 in Figure III-5) and became the standard for projects sites of the consulting team. Although the template became compulsory, the project managers still had discretion to adapt their projects. However, our interview partners did not report any further changes until the end of our observations.

In summary, committed lead actors can drive momentum for weakly embedded routines. The lead actors have goals (e.g., to improve project documentation) and initiate changes that help achieve these goals. Because of their high commitment, lead actors do not stop after a first change but make a sequence of changes, where the results of each change point to ways for further improvement. Weak embeddedness plays a dual role in this configuration. On the one hand, weak embeddedness facilitates making these changes, since other actors can still do their work in similar ways as before and, hence, are unlikely to voice their objections. On the other hand, the lack of input from others also limits momentum for change because suggestions for improvement are only made by the lead actor, resulting in overall moderate momentum of change. Given the dominant role of the lead actor as the source for momentum, we term this configuration dominant lead actor.

4.2.5 Configuration 5: Complex Change

Configuration 5 differs from configuration 4 in that the routine is strongly embedded. It was the only configuration that resulted in high momentum of change. We observed five routines that were instances of this configuration. The product portfolio management routine in the R&D department was one them.

The product portfolio management routine aimed at consistent reporting of Alpha’s product portfolio within the R&D department. Previously, the different divisions of Alpha had different routines for reporting the status of their product portfolios. Since these reports relied on different data and contained different information, the managers were not able not aggregate them to a global report (*relationship to existing artifact:*

absence). Due to the high specialization of the tasks of providing information about the products and due to the high level (department) on which the routine is conducted, this routine qualified as strongly embedded.

The management made the decision to build a new artifact for the product portfolio management routine (*high lead actor commitment*). The responsible project manager decided to build the artifact based on SP because he wanted to involve the different product managers directly. He said: “We get the numbers from the ERP system. However, the pure numbers are not that important. I am interested in the statements. This is information that I can collect with SP.” Therefore, in summer 2014, he created a SP site and defined a structure to represent the portfolio. He used lists and libraries for this representation and combined them in a sophisticated manner by creating columns and using look-ups to connect the lists (major change, see change no. 1 in Figure III-6). He used this version to discuss the artifact with product managers, who were the target users of the routine. In spring 2015, he realized that his chosen structure was not manageable and did not fit the existing structures of the product portfolio management. He created a new SP site and re-created the structures based on his made experiences (major change, see change no. 2 in Figure III-6). Additionally, he became aware of a new technology, Microsoft Power Pivot that he could use to visualize the data. Until January 2016, he made a few more configuration changes to improve the routine (moderate change, see change no.3 in Figure III-6). The project manager presented the current version to the management, who were pleased about the improvements.

In March 2016, the CEO announced that the use of the created artifact was compulsory. This led to more feedback by the users to meet their requirements. The project manager collected this feedback and tried to incorporate it. He summarized: “The main contributors do not gain much value out of using the artifact. I try to resolve this issue, which will hopefully lead to more acceptance.” In a first step, he adjusted the structures of the sites again based on the feedback (moderate change, see change no. 4 in Figure III-6). In a second step in autumn 2016, he provided the users with automatic updates of data through configurative changes (previously he had to update visualizations manually) (moderate change, see change no. 5 in Figure III-6). He still had not satisfied all actors but focused on improvements in the integration of Power Pivot with ERP data and SP. This change demanded complex adaptations of the SP sites (major change, see change no. 6 in Figure III-6). In summer 2017, the project manager focused on the other user demands. He planned to improve the existing input forms with autocomplete and standardized values to allow faster data input (moderate change, see change no. 7 in Figure III-6). The project manager stated in one of the last interviews: “Adaptations to SP to support the routine led to discussions about the routine. This was the real benefit.”

In summary, our analysis suggests that high momentum of change is created when actors decide to support a strongly embedded routine with a new artifact (either replacement or absence of existing artifact). This decision implies high commitment to the change by lead actors. The strong embeddedness leads to major change complexity since actors have to combine the generic functions of SP to support the routine. It also leads to tensions between the artifact and the routine understanding of different actors in all perceived cases. Actors may give feedback that the artifact does not match with their understanding of the routine. The lead actor may react to this feedback and may change the artifact. Hence, high momentum of change results from strong embeddedness, which mobilizes all actors involved in the routine and makes the changes to be performed relatively complex. We therefore term this configuration complex change.

5 Discussion

In this paper, we investigated the complex relationship between routines and artifacts under malleable IT and built on the concept of momentum to describe the intensity of a series of interrelated changes to a routine and to its related artifacts. We found that momentum varied substantially between routines. By comparing routines, we identified the embeddedness of routines, the relationship to existing artifacts, lead actors’ personal traits (particularly personal knowledge and commitment), and external knowledge as influencing factors on momentum of change (represented by change frequency and change complexity). Our emerging theory suggests that different configurations of these factors lead to different momentum of change under malleable IT.

5.1 Contributions

Our research contributes to the literature on organizational routines and artifacts by (1) proposing a model to explain momentum of routine change under malleable IT, (2) uncovering differences between weak and strong embedded routines, and (3) shedding light on the role of existing artifacts in shaping routine change.

Our first contribution lies in proposing an emergent theory that explains the momentum of routine change under malleable IT. The literature on the role of artifacts implicitly acknowledges the key role of momentum by emphasizing long series of changes (e.g., Goh et al. 2011; Leonardi 2011; Volkoff et al. 2007), but it has not theorized or attempted to measure momentum. An important contribution to this stream of research is thus to propose the construct of momentum of change and show how to measure the construct. In line with the literature on artifacts (e.g., Goh et al. 2011), we find that lead actors play a key role for generating sufficient momentum. While our emphasis on lead actors is in line with the literature on artifacts, our study goes beyond that literature by pointing out commitment and personal knowledge as two lead actor characteristics that are particularly relevant under malleable IT. Commitment and personal knowledge are important because malleable IT puts a heavy burden on actors, by requiring them to initiate changes and to conceive ways to configure the malleable IT such that the new version of the routine becomes possible.

It is also insightful to compare our emerging theory with Jansen's (2004) work. Whereas Jansen examined one case of strategic, cultural change in which IT did not play a prominent role, our study examined 24 instances of rather micro-level changes in which change was enabled by the potential of malleable IT. While Jansen's results point to an important role of the commitment of executive change leaders, our findings emphasize the commitment of lead actors. In contrast to executive change leaders, lead actors need not be managers. A lead actor can be any actor involved in a routine who takes the initiative to improve the routine by exploiting the potential offered by malleable IT. Hence, in contrast to strategic change initiatives, routine change enabled by malleable IT requires at least one committed individual that leads the change process, often in absence of any formal mandate. In contrast to Jansen's study, we found not only the commitment but also the knowledge of this actor to be of high importance, which is likely due to the complexity associated with configuring malleable IT (Lehrig et al. 2017).

Our second contribution lies in new insights how embeddedness affects change of routines. Although we had expected that weakly embedded routines would show higher momentum of change than highly embedded routines (Howard-Grenville 2005), we found the opposite. Indeed, few weakly embedded routine artifacts changed more than once within the observation period, whereas strongly embedded routines changed more often. We attribute this to the missing reactions of actors to changes for weakly embedded routines. Thus, when routines were weakly embedded, actors did not enact their agency regarding changes to the artifact (D'Adderio 2011). These struggles among different agencies are an important source of momentum. When routines are weakly embedded, actors do not voice competing views, and the lead actor carries the burden of creating momentum for these routines. Conversely, when routines are strongly embedded, other actors engage more strongly in discussions about how artifacts should support the routine, which drives momentum. Additionally, strongly embedded routines needed a bigger initial change impulse (i.e., higher change complexity) to initiate a change at all. Like a heavier stone needs more effort to start rolling, once it rolls inertia prolongs its movement compared to a smaller stone. Similarly, the higher efforts for initial changes provided more momentum to strongly embedded routines and kept them “rolling”. Although our findings deviate thus from the often articulated idea that strong embeddedness is associated with lower intensity of change (Howard-Grenville 2005), our findings are in line with existing research on routines under hard-to-change IT in which big investments lead to high momentum despite strong embeddedness (e.g., Berente et al. 2016; Goh et al. 2011). In conclusion, we contribute to deepen our understanding of the role of embeddedness in routine change under malleable IT. Higher embeddedness keeps routines persistent in phases of stability since the initial thresholds are higher to initiate changes. But higher embeddedness also keeps routines going in phases of change since the invested efforts mobilize resources and trigger agency.

Our third contribution is the identification of how different relationships to the existing artifacts influence the routine change under malleable IT. Although the importance of artifacts for routines is undisputable (D'Adderio 2011), their role in change processes remains blurry. Existing literature analyzes the replacement or creation of artifacts and their following evolution (e.g., Goh et al. 2011; Leonardi 2011) but does not consider the incorporation of existing artifacts with new IT. Malleable IT facilitates such changes. Incorporation of existing artifacts can easily been overseen since its created momentum for change is minimal. Nevertheless, it is important to understand that incorporation can generate value by allowing the adoption of new IT as SP with minimal change efforts. For replacement and creation, we encountered higher momentum under malleable IT. Although these two scenarios create similar results for momentum, the underlying mechanisms differ. Replacement can drive changes through comparison with and recreation of the existing artifact whereas creation in the absence of existing artifacts can drive changes through the origination and the related struggles (D'Adderio 2011). The differentiation between these three scenarios provides a new perspective that moves attention from properties of the artifact to the relationship of the new artifact with existing artifacts. In sum, we introduce incorporation as a new relationship scenario of existing artifacts in routine change and propose that researchers should pay more attention to the different relationship scenarios of existing artifacts, since this might explain differences in routine changes that cannot be attributed to the properties of the artifact alone.

5.2 Future Research

Our research opens avenues for future research. It would be interesting to have more case studies that analyze routine change under malleable IT. Additional factors as organization related factors could be uncovered that contribute to the extension of our emergent theory. Furthermore, additional case studies with this set-up could test our model. Studies with longer observation periods would also be beneficial. Longer observation periods like in the work of Leonardi (Leonardi 2011, more than 10 years) would help to identify whether momentum of change may varies for artifact that emerge later, e.g., these artifacts may display a lower change frequency than in the beginning because of existing experiences. Our data show antecedents for this possibility. Future research could also widen the scope of observed artifacts and their technologies. Most routines do not solemnly rely on one artifact but on multiple artifacts (D'Adderio 2011). In our study, we focused on SP related artifacts only. The relationship between multiple artifacts could influence momentum of change and would generate a more complete picture of IT induced changes. Advanced analysis methods as the one suggested by Gaskin et al. (2014) could help to achieve this goal. Finally, it would be interesting to generate models for momentum of change under different technologies, e.g., hard-to change IT, and compare them to our model for malleable IT.

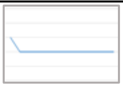
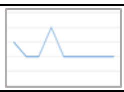
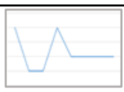
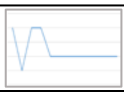
5.3 Practical Implications

Our findings have also implications for praxis. Organizations can use our findings to support adoption of malleable IT. A first insight for praxis is that malleable IT on its own does not create change in organizations. Without commitment of actors, malleable IT only creates low momentum. Actors must give the generic functions of malleable IT a purpose in their routines to change and improve them. This requires commitment and knowledge about the technology. Organizations can use this insight and foster commitment for artifacts among lead actors to generate higher momentum. A second insight for praxis is the effect of different adoption patterns of existing artifacts on momentum. The incorporation of artifacts leads to low momentum whereas replacement and creation of artifacts create higher momentum. Organizations or lead actors can use these different strategies to generate or prevent momentum of routine change depending on available capacities. A third insight for praxis is the huge effect of lead actors on momentum under malleable IT. With malleable IT, knowledgeable and committed lead actors can generate momentum in weakly embedded routines easily. This entails that they can inscribe their perception of routines in the artifacts and use the technology to their advantage. This may lead to complex artifacts, which few actors can maintain. In high fluctuation environments, this could become a problem and lead to repeated creation of artifacts by changing lead actors, which increases efforts. Organizations should be aware of this problem and encourage lead actors consciously hand over artifacts to new lead actors in cases of personnel changes.

5.4 Limitations

Our study has some limitations. First, we relied on data from a single case study (i.e., we observed the identified dynamics only in one organization for one specific technology). In a different set-up, other factors may occur that would extend or alter our emergent theory. We leave this to future research as well as possible replications of our findings. Some conditions from our case may have also hindered the identification of different factors. We have to mention two important conditions. First, due to scarce resources the IT department could not support changes in SP. This put the burden of knowledge acquirement to the actors or their possibilities to fund external support from the consultancy. Second, managers questioned the future of SP during our data collection, which undermined trust of the actors in SP. This led to periods in which actors did not conduct any changes because of the lack of trust. However, we identified similar patterns before and after this period. Thus, we assume that they did not have a lasting effect on our theory.

Appendix III-A. Routine Configuration Overview

Routine	Momentum of Change		Embed-dedness	Existing Artifact	Know-ledge	Commit-ment
Roadmap Management	Low		Weak	Incorpora-tion	External	Low
Company Report Man-agement	Low		Weak	Incorpora-tion	External	Low
Organigram Management	Low		Weak	Incorpora-tion	Low	Low
Project Plan-ning Team Support	Low		Weak	Incorpora-tion	Low	Low
Machine Reservation	Low		Weak	Incorpora-tion	Low	Low
Project Plan-ning Team Consulting	Low		Weak	Incorpora-tion	High	Low
Event Docu-mentation	Low		Weak	Absence	Medium	Low
Document Organization Country A	Low		Weak	Absence	Medium	Low
Audit Docu-mentation	Mod-erate		Weak	Replace-ment	External	Low
Project Doc-ument Or-ganization Team ERP	Mod-erate		Weak	Replace-ment	External	Low
Experi-mental Trial Documenta-tion Division A	Mod-erate		Weak	Replace-ment	External	Low
Experi-mental Trial Documenta-tion Division B	Mod-erate		Weak	Replace-ment	External	Low
Process Doc-umentation Management	Mod-erate		Weak	Absence	External	High
Norm Repos-itory	Mod-erate		Weak	Absence	External	High

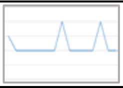
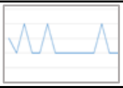
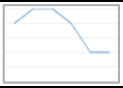
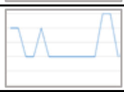
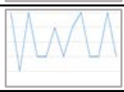
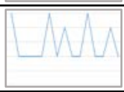
Knowledge Management R&D	Moderate		Weak	Absence	High	High
Team Site R&D	Moderate		Weak	Absence	High	High
Team Site Consulting	Moderate		Weak	Replacement	High	High
Project Organization Team Consulting	Moderate		Weak	Replacement	High	High
Project Reporting Team Consulting	Moderate		Weak	Replacement	High	High
Pending Tasks	High		Strong	Replacement	External	High
Helpline	High		Strong	Replacement	External	High
Investment Controlling	High		Strong	Absence	External	High
Product Portfolio R&D	High		Strong	Absence	High	High
Project Reporting R&D	High		Strong	Absence	High	High

Table III-4 Routine Configuration Overview

Appendix III-B. Coding Examples

Construct	Background Information	Coding Example
Embed-dedness	**High**: Product Portfolio Matrix: Over 30 users contributed with their expert knowledge to create an in-depth overview about the product portfolio. The results of the routine were used to make strategic decisions for the organization.	"The data is provided by different users and additional sources from ERP." "Each unit needs a different view on the data."
	Low: Machine Reservation Routine: Six users coordinated the reservation of machines between two teams. Each user had the full overview about the reservations and could update them on demand.	"For the machine reservation, the complexity is manageable although the users in China are external."
Existing Artifact		
Incorpo-rated	Machine Reservation Routine: Actors used a worksheet (existing artifact) to coordinate machine reservations. Worksheet was stored in SP to make it available in all locations.	"We used this list [worksheet]. Previously, we sent it by mail but did not store the current status centrally. Now, we store it on SP."
Replace-ment	Team Site Consulting: The consulting team used a file share to store documents like templates and budget lists before SP was available. After this they created a site in SP, moved all their documents to SP, and deleted the folders in the file share.	"We started to delete all things from our file share. … We integrated all documents on our new team site in SP."
None	Product portfolio Routine: No consistent artifact existed to support the product portfolio management. Actors created a new artifact with SP.	"This [the portfolio matrix] is completely new." "The brands had some solutions before but nothing consistent."

Personal Trait		
Personal Knowledge	**Low**: Machine Reservation Routine: Lead actor demanded support for changes since they did not have sufficient knowledge.	"If I would have to make any changes, I would demand support again."
	High: Product Portfolio Routine: Lead actor conducted all changes on his own and constantly acquired new knowledge about SP and related technologies like PowerPivot.	"I came in contact with PowerPivot during the project. Now I am a big fan. … It is amazing what I can do with PowerPivot to manipulate the data."
External Knowledge	Norm Repository: The quality manager missed required knowledge to implement a norm repository with SP. He acquired external support (a colleague) to implement the artifact based on his inputs.	"I met with Steve. I told him what I needed and then he prepared a [SP] site for me." "Steve always gives me tasks to think about. Then we meet together and we implement it."
Commitment	**Low**: Machine Reservation Routine: Lead actor used functionalities of SP but would also replace the tool with other solutions. The lead actor did not search for improvements but kept the routine as is although many problems were obvious.	"The project manager [of SP project] came to us and we used SP as shown. If we were told to use something else, we would consider it."
	High: Document Management Routine: The consulting team perceived the created project sites (artifacts) as their tools and tried to fit them to their demands. They committed to the use of the tool and its development.	"I told my team that they have to work on SharePoint from now on." "I put pressure on my team that we create something [i.e., a template for the site] together."

Table III-5 Coding Examples for Constructs

CHAPTER IV CONCLUSION

The goal of this dissertation is to enhance the understanding of user-driven change under malleable IT. The three presented studies provide different insights to achieve this goal. In this chapter, I summarize and conclude the implications of this dissertation for research and practice.

1 Implications for Research

The developed theories in this dissertation help to explain how individual users can utilize malleable IT to change the way they and their colleagues conduct their work. The dissertation does so by analyzing two perspectives: single changes on the user level and consecutive changes on the routine level. These perspectives utilize different theoretical foundations. The first perspective is based on affordance theory and incorporates social cognitive theory whereas the second perspective utilizes routine and momentum of change theory. The contributions to these literature streams are explained in detail in the individual studies. An aggregation of the most important implications for research based on the three studies is presented next. Afterward, I briefly summarize the limitations and present the possible avenues for future research.

The potentials of malleable IT are at the core of this dissertation. These potentials only unfold if users actualize them for their goals (Richter and Riemer 2013). The existing IT and feature use research is not an appropriate lens to analyze this kind of IT, as the actualization of goals not only requires the application of existing features but also endowing them with meaning. Therefore, this dissertation adopts the view of affordance theory, namely, that objects such as IT provide potentials to actors. This is consistent with recent research that analyzes how IT is not only used but also applied to achieve meaningful goals (Burton-Jones and Volkoff 2017; Leidner et al. 2018; Strong et al. 2014). This actualization process contains affordance perception and actualization as separate steps. Studies 1 and 2 showed that affordance perception, in particular, has an exposed meaning for malleable IT since the meaningful goals need to be discovered by the users if organizations provide them with high discretion. The identified affordance perception processes in Study 1 present the different ways that users can perceive affordances. These processes are enhanced (through being pushed), clustered, and tested in Study 2. This study also provides the first evidence for the strong relationship between affordance perception and actualization under malleable IT. The emphasis on affordance perception under malleable IT is a central contribution of this dissertation that is absent from current research.

The affordance actualization part is also covered in Study 1 and provides explanations as to why actualizations may get stuck. The transition from perceived affordances to their actualization often required the configuration of the malleable IT. Such adaptations are a central property of malleable IT (Kallinikos et al. 2013; Schmitz et al. 2016). Study 1 identified different processes by which these adaptations materialize in praxis. However, it also showed that configurations are often an obstacle that prevents actualizations under malleable IT. Thus, even if users had perceived affordances, they may lack the possibility of putting them into action and may be unable to invest further efforts. Study 1 showed that different possibilities exist to configure malleable IT (guided, delegated and independent configuration), and these depended on the direct environment (i.e., advice network) or personal capabilities (i.e., technical knowledge about the malleable IT). In particular, the technical knowledge of users was a recurrent capability of users in this dissertation that fostered the effective use of malleable IT. In Study 3, the technical knowledge of users also led to a higher momentum of change. Users with technical knowledge about the malleable IT utilized this knowledge to support their routines and did this not only once but continuously. Thus, individual technical knowledge about a technology is an important factor for user-driven change under malleable IT. This finding is the second contribution of this dissertation.

The dissertation also showed that user-driven change under malleable IT not only depends on individual users but also on their local environments. Factors like advice networks, technical knowledge of other users (Study 1), deliberate initiatives (Study 2), or the embeddedness of routines (Study 3) all influenced users' behavior. Although these factors were present in existing research and related to either adoption, behavioral changes or limitations for change (e.g., Howard-Grenville 2005; Sun 2012; Sykes et al. 2014), this dissertation uncovered their role in the context of malleable IT. The different environmental factors influenced how users could perceive and drive change for their routines. The different users, although all part of the same organization, had very different possibilities for utilizing the malleable IT, which was derived from their local environments. It is important to consider these environments, when developing further theories about user-driven change under malleable IT. This dissertation provided the first suggestions on how to do so. The stronger emphasis on local environments is the third contribution of this dissertation.

This dissertation also has some limitations. The most important limitation is that all data was collected from a single organization. This allowed for detailed descriptions and consistent settings for all three studies, but it also limited the generalization of the results. Therefore, replication of the results is required to strengthen the developed theories. The open policy to adapt and modify SP by users at Alpha, in particular, was quite a special setting. Although this allowed me to observe the unfolding of malleable IT at the user level without formal restrictions, it also may have prevented tensions in a more restrictive scenario that may have generated additional potentials (see results from Study 3 regarding embeddedness). An additional limitation was the limited support by the IT department of Alpha, which that may have fostered retention of the technology at the user level because users may have felt as if they were left on their own. This circumstance may have also prevented required knowledge injection from sparking more usage scenarios. Overall, replications of the studies under different settings (e.g., different organizations or different malleable IT) are required.

The single studies already suggested some avenues for future research. Considering the studies examined in this dissertation holistically, I want to add three more avenues for future research that derive from the conducted research in this dissertation. First, one avenue is to aim for a tighter integration of affordances and effective use in malleable IT research. In this dissertation, I analyzed affordance actualizations and their influence on routines. However, I did not question whether these affordance actualizations led to effective use (i.e., supported the desired goals of the organization) (Burton-Jones and Volkoff 2017). The individual affordance actualizations may lead to personal optimizations at the user level, in which the users applied the malleable IT to manifest their personal goals (D'Adderio 2011), but not necessarily acting in a beneficial way from an organizational perspective. Recent research has begun to identify context-specific affordances and the influence of their actualization on the organizational level (Burton-Jones and Volkoff 2017; Leidner et al. 2018; Strong et al. 2014). For malleable IT, such approaches would also be interesting, although the resulting affordance networks may reach a much higher complexity since the IT provides so many potentials. A possible approach would be to use techniques like complex adaptive systems to model the emerging bottom-up affordance actualizations and their effect on organizational goals (Nan 2011). The application of such techniques could help to uncover processes and conditions that not only lead to affordance actualizations under malleable IT but also consider the effectiveness of these actualizations at the organizational level.

A second avenue for future research is the subtle transformation of malleable IT artifacts into hard-to-change IT artifacts. An initial idea for this dissertation was to analyze how and when routine artifacts evolve from malleable easy-to-adapt artifacts to complex, persistent artifacts over time. The idea relied on the concept of imbrications between routines and their related artifacts (Leonardi 2011). The suggestion was that at a certain point the malleable character of the artifact diminishes through repeated changes, and the artifact petrifies more and more. This suggestion was partly confirmed through observations in Study 3. Unfortunately, we observed such repeated imbrications in very few cases, so we could not develop a satisfying theory. A higher number of observed users or an ex post analysis of petrified artifacts could provide sufficient data. Insights from such data could help to provide guidance on how malleable IT could act as an incubator for artifacts in the early phases of routine evolutions and uncover conditions when such petrification appears.

A third avenue for future research is an enhanced analysis of advice networks and their influence on effective use and user-driven change under malleable IT. In this dissertation, the influence of advice networks was observed only through narrations in interviews (Study 1) and approximations in a survey (i.e., other people's use, Study 2) but not further explicated (e.g., Sykes et al. 2014) or directly observed, as in ethnographic research. Further details about the advice network structures and the exchanged information would be insightful for analyzing the distribution of usage scenarios for malleable IT. A longitudinal perspective is necessary to observe these mutations. The structures of the advice networks may help to explain why malleable IT implementations lead to high adoption and user-driven change in parts of organizations but may fail in other parts. Additionally, possible negative effects of advice networks in combination with malleable IT should be analyzed, such as the spread of inferior solutions through advice networks that limit the effective use of malleable IT.

2 Implications for Practice

The findings of this dissertation provide guidance for organizations and individual users in the utilization of malleable IT in practice. On the organizational level, the results of this dissertation showed that malleable IT is not a driver of change on its own. Each user in these studies needed to find meaningful usage scenarios for the malleable IT, without which the malleable IT would have been useless. Thus, organizations need to either define usage scenarios for the malleable IT to induce change potential or they need to provide impulses for users to stimulate user-driven change. The results of this dissertation suggest that organizations could do so by fostering an exchange about the use of the malleable IT between users. This would allow users to observe how others utilize the malleable IT. Additionally, this would also provide the users with contacts to exchange advice and would allow them to ask for help for configurations. Thus, the creation of such stimulating local environments supports the adoption of malleable IT. The exchange among users about the malleable IT can also drive change momentum if “external” users suggest ideas to enhance or modify the use for a specific routine. Furthermore, organizations should identify users that are willing to build up technical knowledge about the malleable IT. Such users are also sources of user-driven change through transferring and exploring. These strategies only make sense if organizations are interested in bottom-up change that is difficult to predict and require discretion for the users. Otherwise, a strategy should be applied that prescribes usage scenarios. However, this would restrict the potential for malleable IT.

The three studies in this dissertation also showed the versatile character of malleable IT. The users utilized the malleable IT for different usage scenarios. Organizations can benefit from the application of malleable IT for the support of routines that are in creation, although actors of such routines may need to develop an understanding of the routine and how it could be supported. Malleable IT provides the required flexibility to do so. The same is true for routines that are not supported by other existing IT in the organization. Such routines could also use malleable IT to evolve. This evolution could lead to an integration into existing IT over time that is enabled by the malleable IT. However, in both scenarios, the developments of resulting artifacts highly depend on the capabilities of lead actors and their commitment to the routine. Here the decision for a suitable lead actor can lead to a high momentum for change.

Despite the potentials, malleable IT also carries risks for organizations. The resulting artifacts in our studies were developed with little governance support by the IT department and therefore strongly depended on individual users. The artifacts often remained unused if active users left the organization. Such legacy artifacts may result in high efforts due to repeated “inventions” of artifacts for the same use cases. Organizations must find a balance in their governance of malleable IT to allow user-driven change but also to stabilize resulting changes to gain maximum benefits from the outcomes. A repository to document existing artifacts based on malleable IT may help organizations keep an overview and allow them to take action, if needed.

On the individual level, this dissertation also has implications for praxis. In the given context of the study (i.e., high discretion to adapt the malleable IT), users receive a mighty tool to support and drive change in their local environments. They can use malleable IT to manifest their views in artifacts and to enforce them in routines. Although other factors, like power constellations, are also important in such processes, the artifacts based on malleable IT can make a difference. Thus, malleable IT allows users to induce change in their local routines. Users can utilize this for their personal development and strengthen their position. This dissertation implies that users need to develop capabilities to utilize the malleable IT. Thus, they can either increase their technical knowledge about the malleable IT or build a strong advice network to rely on. Users that take these investments and leave their comfort zone can benefit from the utilization of malleable IT by driving change in their routines.

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T. Lehrig

Bern, 23.11.2018 Tim Lehrig